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U.S. Department of Transportation

Federal Aviation Administration

National Airspace System Plan

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Facilities, Equipment and Associated Development

April 1984

Congressionally Requested Update

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FOREWORD

The second edition of the National Airspace System Plan for Facilities, Equipment and Associated Development was released in April 1983. During the past year, the Federal Aviation Administration has, per Congressional mandate, reviewed and updated that document into this 1984 edition. This edition reflects the system definition and subsystem decisions the agency has made over the past year. The plan will continue to evolve as aviation demands dictate and, therefore, should be considered as a program plan rather than a budget document.

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CHAPTER I

EXECUTIVE SUMMARY AND OVERVIEW

EXECUTIVE SUMMARY

In December 1981, the Federal Aviation Administration (FAA) charted a comprehensive plan for modernizing and improving air traffic control and airway facilities services from now to the year 2000. The Airport and Airway Improvement Act of 1982 requires an annual revision of that plan, and this document satisfies that requirement.

This revised edition of the plan is essentially the same as the original plan. It reflects minor changes in some programs as well as additional information. It provides updated forecasts affecting expected future staffing requirements. It incorporates results of further consolidation studies.

The plan addresses the compelling problems of how to best accommodate spiraling demands for aviation services, constrain costs, recast the required technical framework, and deal with aging facilities.

It delineates specific improvements to FAA facilities and equipment and the supporting research and development associated with changes to the National Airspace System which are being implemented.

Particular emphasis is given to air traffic services, including terminal and en route air traffic control; flight service stations and weather services; ground-to-air services, including surveillance, navigation, and air/ground communications; interfacility communications; and services such as airway facilities maintenance and flight inspection of navigational aids.

The recurrent theme throughout the plan is that safety, capacity, productivity, and economy will be realized chiefly through higher levels of automation, consolidations of major facilities, and the application of rapidly changing and lower-cost technologies in telecommunications.

FAA recognizes that implementing the plan will be expensive and may proceed more slowly than many would wish. However, the agency is certain that the measures contained in the plan are essential to flight safety, efficiency, and economy and must continue in order to meet the projected needs and demands of U.S. aviation. To assist the agency in this major undertaking, a systems engineering and integration contractor has been employed. This plan will continue to evolve as aviation demands dictate and, therefore, should be considered as a program plan rather than a budget document. Since assumptions and constraints in both may vary slightly, the budget should be used as the authoritative source for current budget-year information.

OVERVIEW

INTRODUCTION

Today's air traffic control and air navigation system is a combination of equipment, techniques, procedures, and skills that have evolved over 40 years. This evolution has produced a mixture of equipment of many ages, technologies, and types. It is the safest, most efficient system in the world—but it is very expensive to operate and maintain, expansion capability is limited, and adaptability is difficult.

The compelling issue is how to best deal with spiraling demands for aviation services, constrain costs, recast the necessary technical framework, and deal with the problem of aging facilities. And, FAA must do this in a way that conforms with the guiding principles that FAA will control but not constrain, regulate but not interfere, and recognize that most air travelers do so by air carriers. FAA has the special responsibility to consider their priority, but not to the exclusion of the single individual who chooses to enjoy solo flight.

The need for modernization provides a unique opportunity for FAA to review its plans with respect to its goals and the needs of the user community. The overall goal is to develop a total system which relates the needs of the user community to the systems designs, operations, and human factors needed to modernize today's systems and provide a framework for the system of the future. The primary objective is safe and efficient transportation for all people who use and depend upon the National Airspace System.

Today's system is characterized by:

- Vacuum tube-type electronic equipment and its associated high operations and maintenance costs.
- Different types of computers and software in each air traffic control (ATC) subsystem.
- Different types of controller consoles and display equipment in en route and terminal facilities.
- Multilayered, overlapping coverage of navigational aids, communications sites, and surveillance facilities.
- A large number of individual ATC facilities with the accompanying overhead costs.
- A large number of leased communications lines and equipment.
- Extensive supply, training, and technical support facilities.

Expanding today's system to meet the needs of the next two decades will only amplify its current shortcomings. The system needs a complete modernization, and this will require a consistent level of funding.

The Airport and Airway Improvement Act of 1982 established an authorized level for facilities and equipment (F&E) and airport grants. Because the users are the principal beneficiaries of the major improvements outlined in the plan, the Act also established a schedule of user fees.

New directions have been charted. The contents of this particular document reflect FAA's best judgments about what is required to modernize the National Airspace System. It is, in effect, a total system approach—flexible enough to: accommodate future demands and technology, improve vital safety services, increase productivity, constrain costs, reduce the Federal role, allow for a rational system evolution, and recognize the user's desires for minimal restrictions on the use of the airspace.

Equally important, the plan permits the system to accommodate the growing aviation demands at a dramatically higher level of efficiency. This translates into reduced delays and savings in both time and fuel consumption.

FAA believes that this plan will achieve dramatic improvements and that it represents a practical way to achieve a significantly safer and more efficient system, while constraining costs in the longer term.

This plan has been developed in conjunction with other agency actions to review airspace use, including the National Airspace Review, the Rotorcraft Master Plan, and the National Airport System Plan (the forerunner of the National Plan of Integrated Airport Systems). It will accommodate recommendations resulting from those efforts.

GOALS

The central objective of this plan is to provide for the safe and efficient use of the nation's airspace, while minimizing constraints on its use. The operation of the system to meet this central objective must itself be efficient. Specific objectives include:

- Having an operating National Airspace System in place that meets the national aviation demand at the time it is required.

- Accommodating increasing demand in a way that allows airspace users to operate with a minimum of artificial constraints and with fuel efficiency.

- Developing techniques for more accurate classification and counting of operational errors by 1983; reducing operational errors by 80 percent between 1983 and 1995.

- Reducing risks of midair and surface traffic collisions, landing and weather-related accidents, and collisions with the ground.

- Increasing air traffic controller and flight specialist productivity by a factor of at least two by the year 2000, compared with 1980.

- Reducing the technical staff required to maintain and operate the modernized and expanded system by one-third by the year 2000, compared with 1980.

- Maintaining the overall cost of operations of the National Airspace System at the 1980 level, when adjusted for inflation, excluding the capital cost of modernization.

ASSUMPTIONS

During the analysis leading to the plan, a number of premises were considered to be logical and valid assumptions. For example:

- Aviation demand will grow significantly during the next 20 years.

- Air carrier routes and services will reflect a better balance between trip frequency and cost than would be the case under a closely regulated system. The industry will be affected by the deregulation process for several more years before routes and schedules stabilize.

- The commuter airline industry will be affected by deregulation for several more years. Anticipated growth will require many years of adjustment before routes and schedules stabilize. The number of commuter operators is expected to decrease slightly over the period.

- The rapid growth in business use of general aviation will continue. Significant growth in turbopowered aircraft will result in increased operations above 12,500 feet. This growth is expected even though both fixed and variable costs of operating aircraft are expected to increase.

- General aviation aircraft and hours flown will nearly double in the next two decades.

- The number of helicopters and helicopter operations will continue at a high growth rate. City-center to city-center operations are expected to be commonplace by the turn of the century.

- System limitations on any class of users' right-of-access to the system should be imposed only when no other recourse is available to ensure the common good. Any such restrictions should be removed as soon as possible and not be considered a final solution. However, to gain access to the system, individual users must comply with conditions applicable to all classes of users and essential to the safety and efficiency of the system.

- Specific equipment may be required to operate in designated airspace.

- Individual user's preferences for routes, runways, approaches, altitudes, etc., may not be honored if they will cause delays to other users.

- No change to the system will be permitted to reduce safety or increase risk. A very high level of midair collision protection, including a backup ground independent airborne separation device, called traffic alert and collision avoidance system (TCAS), will be available. "See-and-be-seen" operations will continue.

- Few new air carrier airports are anticipated and most major airports have limited expansion capability due to physical, environmental, airspace, runway, and/or landside limitations. These factors will continue to impose capacity constraints at many large and medium hub airports.

- A limited amount of additional capacity will be achieved primarily through reduction in separation standards resulting from technological advances, through refinements in ATC procedures, and through runway, terminal, and access improvements. Solution of wake vortex problems will reduce delays, but will not eliminate them entirely. National policies on noise abatement will affect all of these assumptions.

- The airspace structure demands on participants will continue at several levels. There will be airspace in which no services are available and none needed. The National Airspace Review is likely to have positive impact on the airspace structure and is, therefore, likely to affect this plan.

- Fuel will be available, but at increasing cost. The only fuel constraint used in developing the demand forecasts in this plan is that of price.

THE PLANNING PROCESS

This plan is the second revision of an FAA systems engineering effort which began in March 1981 and concluded with the publication of the NAS Plan in December 1981. It is aimed at meeting FAA's commitment to safe and efficient flight.

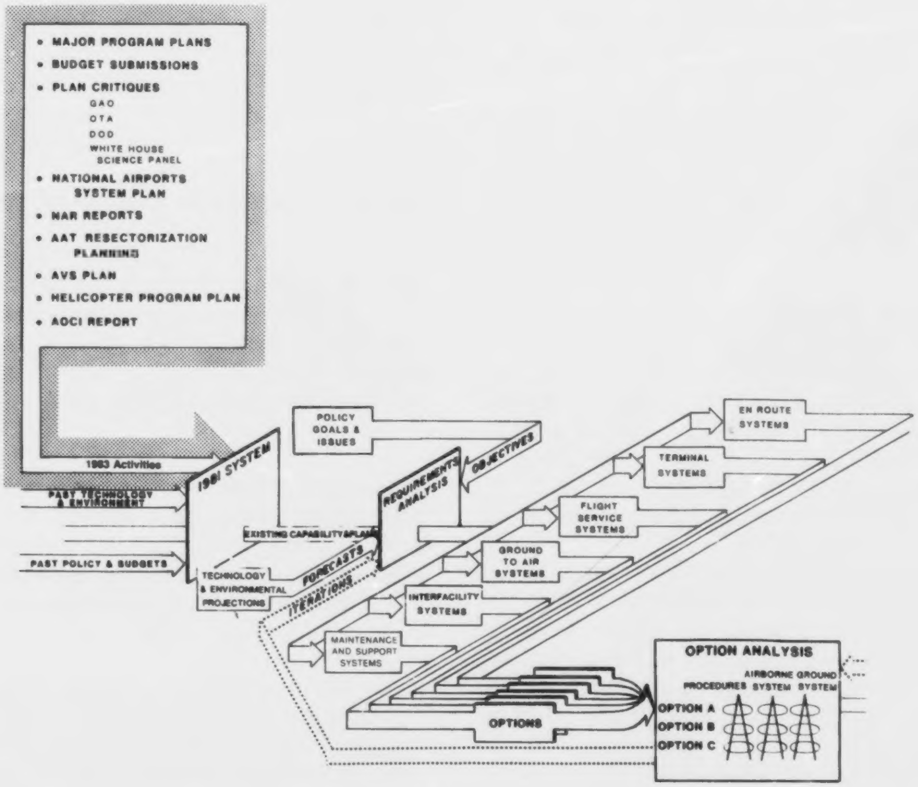
The planning process involved a multidisciplined team composed of representatives of most FAA organizations who participated in an iterative process to define services, systems, and equipment and develop specific action plans reflecting senior management policy discussions, goals, and objectives.

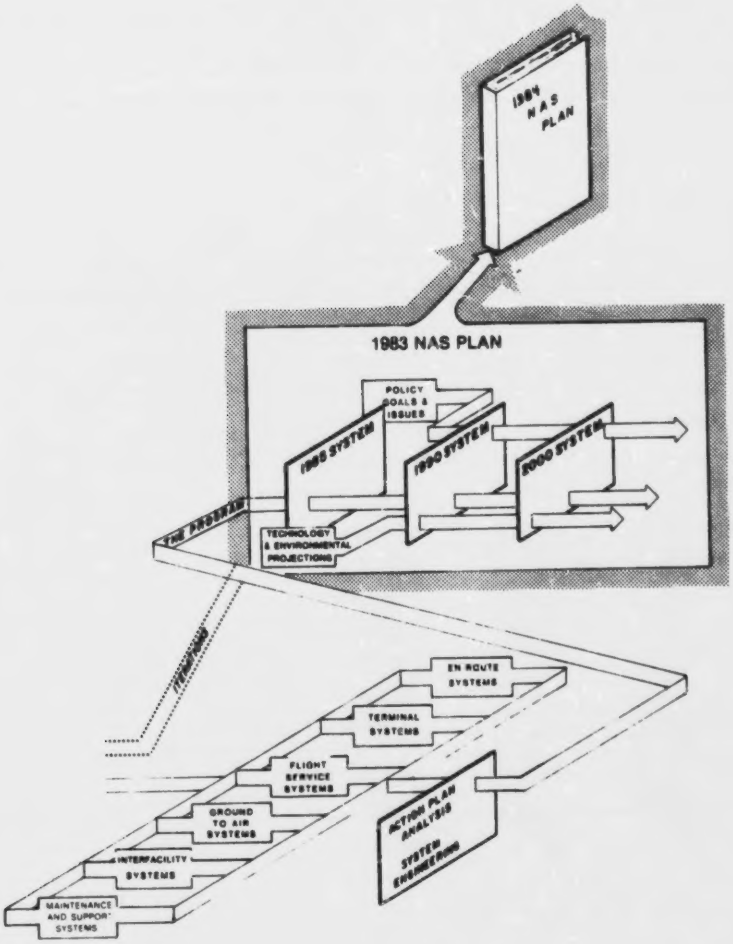
The process began with analyses of current services, system capabilities, equipment, and programs along with projections of required services, future technology, and forecasts of traffic demand and mix. Options were analyzed and plans were created to incorporate capabilities within the framework of the separate elements constituting the National Airspace System.

From developed plans, system programs were formulated and evaluated against basic policy guidelines, objectives, and budgetary implications. Additionally, each system examined served as the basis for analysis of every other system. This led to an iterative process of continuing reviews, ensuring that projects were consistent within each system and between systems and, most important, *compatible* with the agency's goals. This process is depicted in the following illustrations.

Consideration was given to the necessary expansion of the system to meet anticipated future demands, provide improved safety and services, reduce operating costs, and modernize and replace aging facilities and equipment over the next two decades.

This year's plan was updated through essentially the same process as was used in 1981; however, the participation in the planning group included representatives of more elements of the agency and the Department of Defense. The revised plan reflects revisions to the status of each program and incorporates the results of further planning, studies, and decisions that were made in the past year.


• MAJOR PROGRAM PLANS
• BUDGET SUBMISSIONS
• PLAN CRITIQUES
GAO
OTA
DOD
WHITE HOUSE SCIENCE PANEL
• NATIONAL AIRPORTS SYSTEM PLAN
• NAR REPORTS
• AAT RESECTORIZATION PLANNING
• AVS PLAN
• HELICOPTER PROGRAM PLAN
• AOCI REPORT
1983 Activities
PAST TECHNOLOGY & ENVIRONMENT
PAST POLICY & BUDGETS
1981 SYSTEM
POLICY GOALS & ISSUES
OBJECTIVES
REQUIREMENTS ANALYSIS
EXISTING CAPABILITY&PLANS
TECHNOLOGY & ENVIRONMENTAL PROJECTIONS
FORECASTS
ITERATIONS
EN ROUTE SYSTEMS
TERMINAL SYSTEMS
FLIGHT SERVICE SYSTEMS
GROUND TO AIR SYSTEMS
INTERFACILITY SYSTEMS
MAINTENANCE AND SUPPORT SYSTEMS
OPTIONS
OPTION ANALYSIS
PROCEDURES
AIRBORNE SYSTEM
GROUND SYSTEM
OPTION A
OPTION B
OPTION C


1984
NAS
PLAN
1983 NAS PLAN
POLICY
GOALS &
ISSUES
1985 SYSTEM
1990 SYSTEM
2000 SYSTEM
THE PROGRAM
TECHNOLOGY
& ENVIRONMENTAL
PROJECTIONS
EN ROUTE
SYSTEMS
TERMINAL
SYSTEMS
FLIGHT
SERVICE
SYSTEMS
GROUND
TO AIR
SYSTEMS
INTERFACILITY
SYSTEMS
MAINTENANCE
AND SUPPORT
SYSTEMS
ACTION PLAN
ANALYSIS
SYSTEM
ENGINEERING

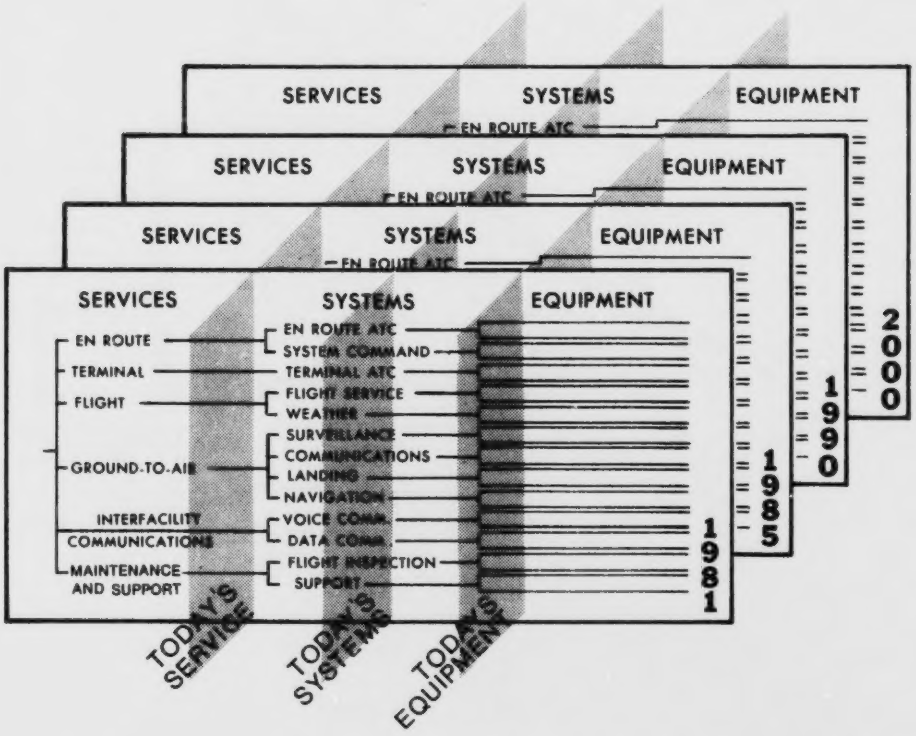
THE STRUCTURE OF THE PLAN

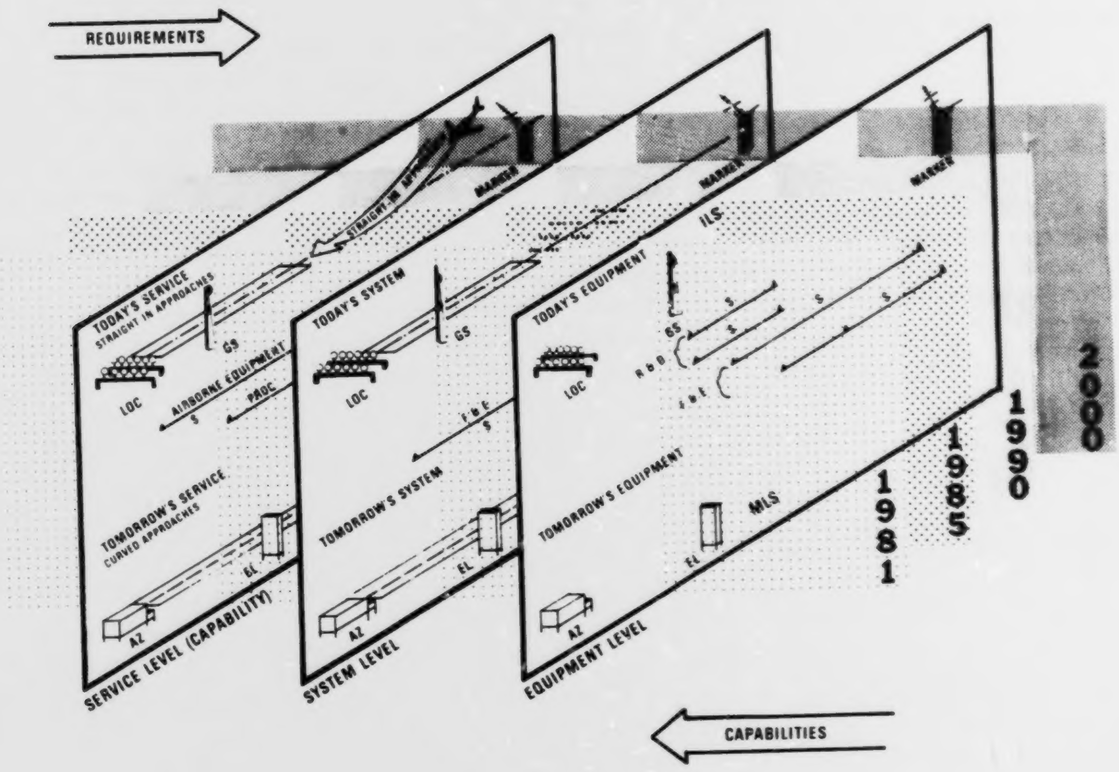
There are five chapters in the plan in addition to this overview. The first is a compilation and discussion of information about demand on the system. Each of the remaining four chapters represents a major element or portion of the National Airspace System. Each chapter contains a narrative description of the current system and its evolution through the near term (1981-1985), intermediate term (1985-1990), and long term (1990-2000). The evolution is also shown in evolution diagrams which indicate the relationships between projects and systems.

The description is further illustrated by a series of maps depicting changes in equipment locations in each of the so-called "snapshot" years: 1981, 1985, 1990, and 2000. This is followed by short discussions, graphs, and charts indicating the effects of implementation of the plan on operating costs and staffing. The remaining portion of each chapter provides a description of the major facilities and equipment (F&E) projects and the research and development (R&D) projects supporting these elements or leading to the acquisition of systems, equipment, or software programs. Each project provides the purpose of the project, the approach to be taken to meet a specific need, the expected product including the quantities being acquired, and a listing of related projects. At the bottom of each project sheet are two charts depicting the schedules or major milestones to be met, both for F&E and R&D portions of the project. Some projects may be F&E acquisitions of existing technology or off-the-shelf systems that do not require R&D efforts. Others may require R&D efforts for the development of systems or software.

Included as part of this plan are many related development projects that are complementary to the F&E programs. These programs are described in a separate report entitled "National Airspace System Plan for Engineering and Development." It is a comprehensive blueprint for R&D efforts. It covers those R&D/F,E&D projects supporting implementation of the NAS Plan, projects leading to improvements in aviation safety, and advanced developments leading to the evolution of the system beyond the year 2000.

The same in-depth analysis accomplished for the F&E programs was applied to the R,E&D and facilities, engineering, and development (F,E&D) programs. Current and future requirements, system evolution, and required project plans were developed.


SERVICES
SYSTEMS
EQUIPMENT
EN ROUTE
TERMINAL
FLIGHT
GROUND-TO-AIR
INTERFACILITY COMMUNICATIONS
MAINTENANCE AND SUPPORT
EN ROUTE ATC
SYSTEM COMMAND
TERMINAL ATC
FLIGHT SERVICE
WEATHER
SURVEILLANCE
COMMUNICATIONS
LANDING
NAVIGATION
VOICE COMM.
DATA COMM.
FLIGHT INSPECTION
SUPPORT
1981
1985
1990
2000
TODAY'S SERVICE
TODAY'S SYSTEMS
TODAY'S EQUIPMENT


REQUIREMENTS
MARKER
MARKER
MARKER
STRAIGHT IN APPROACHES
ILS
TODAY'S SERVICE
STRAIGHT IN APPROACHES
GS
LOC
AIRBORNE EQUIPMENT
S
PROC
TOMORROW'S SERVICE
CURVED APPROACHES
EL
AZ
SERVICE LEVEL (CAPABILITY)
TODAY'S SYSTEM
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LOC
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TOMORROW'S SYSTEM
EL
AZ
SYSTEM LEVEL
TODAY'S EQUIPMENT
GS
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S
S
LOC
TOMORROW'S EQUIPMENT
MLS
EL
AZ
EQUIPMENT LEVEL
1981
1985
1990
2000
CAPABILITIES

HIGHLIGHTS OF THE PLAN

EN ROUTE AND TERMINAL ATC

With regard to en route and terminal systems, the plan has three principal thrusts:

- Major facilities will be consolidated from more than 200 today to less than 30 by the year 2000.

- Common modular computers, software, and controller work stations (i.e., sector suites) will increase capacity and availability.

- Higher levels of automation will improve safety, fuel efficiency, and productivity.

En route and terminal facilities will be consolidated into area control facilities (ACF) with most hardware and software elements identical. The central computers and sector suites used will be identical at all ACFs.

Within each ACF, the advanced automation system (AAS) will have computer processing divided between common processing equipment and the individual sector suite. Sector suites will provide a new environment in which air traffic controllers function more effectively. In a typical sector suite, multiple displays will provide a plan view of the air traffic and weather situation, alphanumeric flight and weather data and other aeronautical information such as notices to airmen, and traffic planning data including the ability to probe the system for conflict-free, fuel-efficient flight paths. Sector suite processing and the fail-soft and emergency modes of the AAS will ensure that required surveillance, flight data, and weather information are available at the particular controller position.

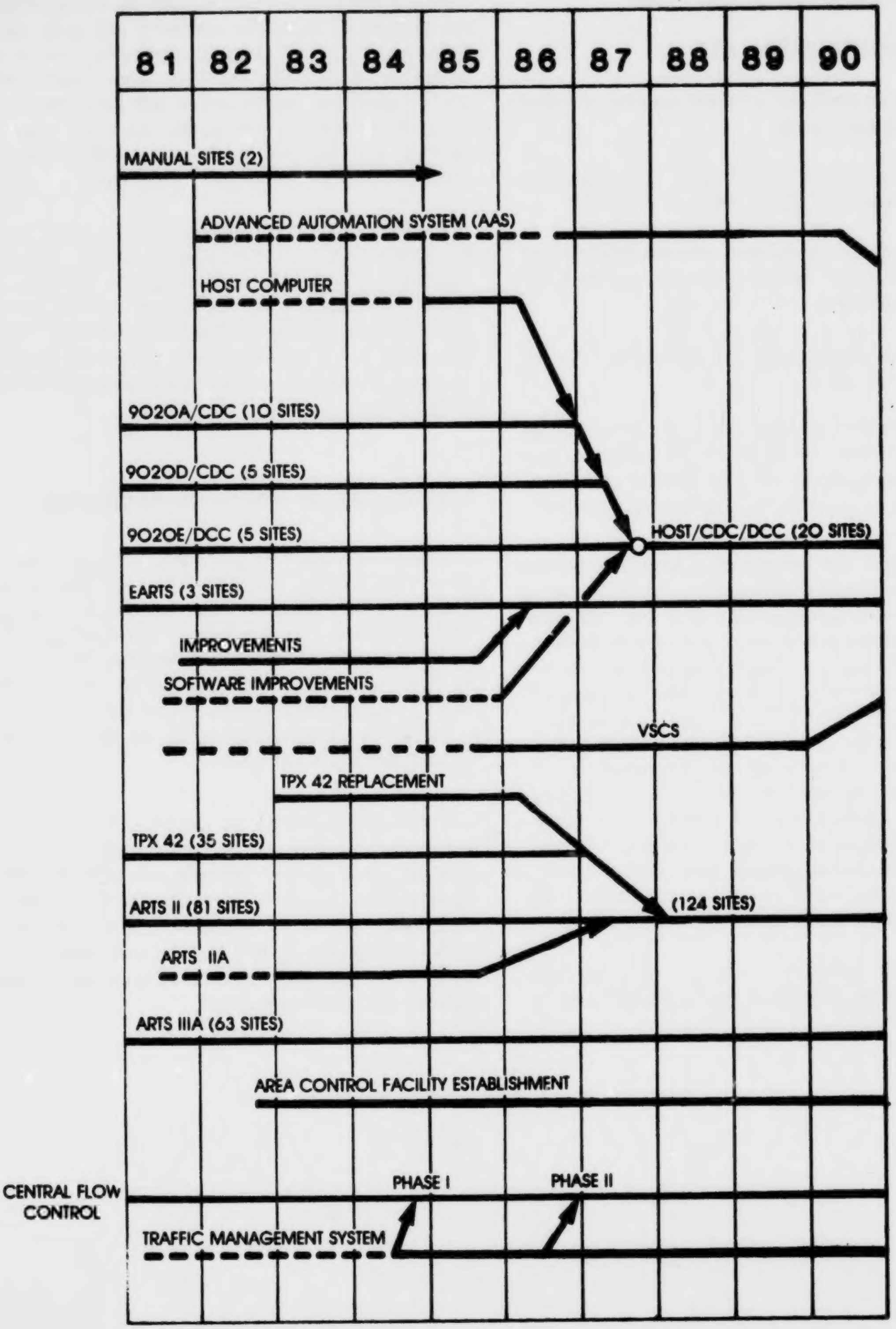
Distributed processing will inherently provide high availability and protection from total system failure. Increased operational flexibility can be achieved since the number of controller operating positions can be reconfigured to meet changing demand based on day-to-day or hour-to-hour workload requirements. When traffic decreases, sector suites and associated communications can be configured into larger operating sectors; and the total number of operating positions and associated staffing can be reduced.

The advanced functions of automated en route air traffic control (AERA) will be added in incremental steps. Direct fuel-efficient route planning, flow planning, and traffic management will be added before strategic planning and full tactical clearance generation. During the period of the plan, computer-generated clearance messages, weather, and flight information will be transmitted directly to aircraft via data link.

CONSOLIDATION AND STANDARDIZATION

Substantial productivity gains and reduced costs will be realized through consolidation. Post 1990 en route and terminal functions will be consolidated into area control facilities. The consolidation will transform 25 en route centers and 188 terminal facilities into less than 30 major air traffic control facilities by the turn of the century. Supporting air traffic control towers will remain in place and will be supported by advanced processing and display capabilities.

System standardization will establish a family of FAA automation, display, and communication systems that provide a wide range of benefits and cost reductions. Systems standardization reduces life-cycle costs due to common operations and maintenance techniques, common engineering and staff support, lower investment in development and procurement, and common logistics and training support.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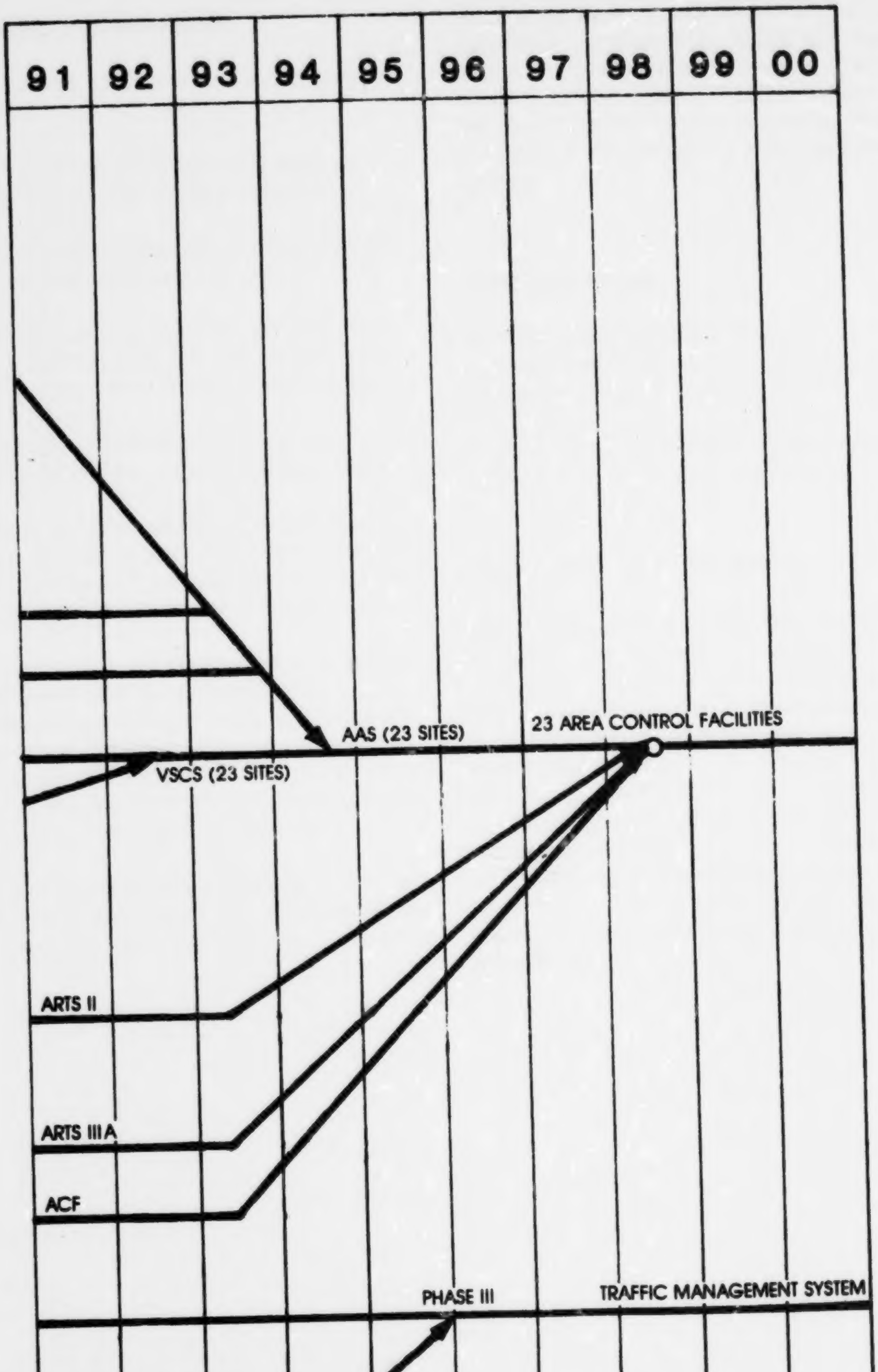
MANUAL SITES (2)
ADVANCED AUTOMATION SYSTEM (AAS)
HOST COMPUTER
9020A/CDC (10 SITES)
9020D/CDC (5 SITES)
9020E/DCC (5 SITES)
HOST/CDC/DCC (20 SITES)
EARTS (3 SITES)
IMPROVEMENTS
SOFTWARE IMPROVEMENTS
VSCS
TPX 42 REPLACEMENT
TPX 42 (35 SITES)
ARTS II (81 SITES)
(124 SITES)
ARTS IIA
ARTS IIIA (63 SITES)
AREA CONTROL FACILITY ESTABLISHMENT
CENTRAL FLOW CONTROL
PHASE I
PHASE II
TRAFFIC MANAGEMENT SYSTEM



EN ROUTE AND TERMINAL ATC SYSTEMS EVOLUTION

FLIGHT SERVICES AND WEATHER

Flight service systems include flight service stations and aviation-related weather systems.

In summary, the plan makes the following three points regarding flight services and aviation weather.

- Automation and consolidation will allow better, more complete services while constraining costs.

- Direct automated pilot access will provide "one-stop" service for weather, flight plan filing and information about ATC system status (delays, outages, etc.).

- Greatly improved aviation weather services will increase safety and be tailored to meet individual needs.

The system will have the capability to provide the majority of flight services directly to pilots without specialist intervention. The system will also provide weather data base access to specialists on an interactive basis.

A consolidated weather position operated by a meteorologist will be developed for each center to include aviation weather collection, processing, and dissemination. The intent is to provide current aviation weather information throughout the National Airspace System for pilots, center and tower controllers, flight service specialists, and traffic management personnel.

Automatically composed, routine en route and terminal weather will be broadcast to pilots over a national VOR network with coverage down to 2,000 feet above the terrain.

Automated weather information will be available via data link to pilots down to 12,500 feet mean sea level and at designated terminal areas by 1991. Coverage will be extended down to 6,000 feet mean sea level by the year 2000. Request/reply service will be provided as well as the transmittal of significant meteorological reports.

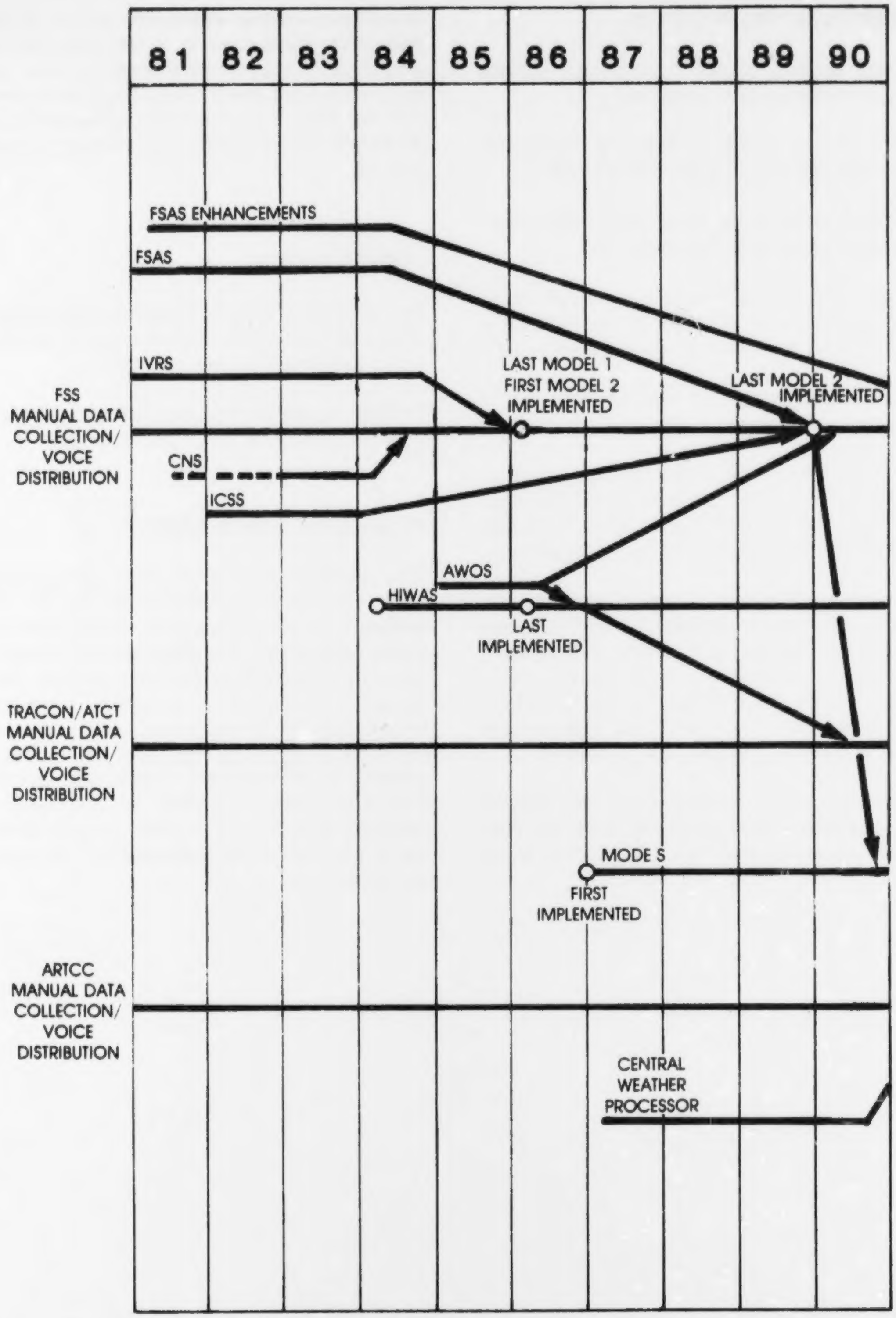
CONSOLIDATION

By 1990, more than 300 nonautomated FSSs will be absorbed into 61 new automated facilities that provide improved service at reduced costs.

Productivity will be significantly improved and maintenance and support costs decreased.

NEAR-TERM IMPROVEMENTS

The implementation of the flight service automation system in the near term provides for the immediate availability of more timely products and increased specialist productivity. The flight service automation system is the basis for direct user access. An interim system will be acquired to provide immediate direct user access for a limited set of weather products without an accompanying flight plan filing capability. The addition of new weather products, such as those available from weather satellites and automated weather sensors, and the replacement of antiquated equipment, such as current teletypewriter machines, will be expedited.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FSAS ENHANCEMENTS
FSAS
IVRS
LAST MODEL 1
FIRST MODEL 2
IMPLEMENTED
LAST MODEL 2
IMPLEMENTED
FSS
MANUAL DATA
COLLECTION/
VOICE
DISTRIBUTION
CNS
ICSS
AWOS
HIWAS
LAST
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MANUAL DATA
COLLECTION/
VOICE
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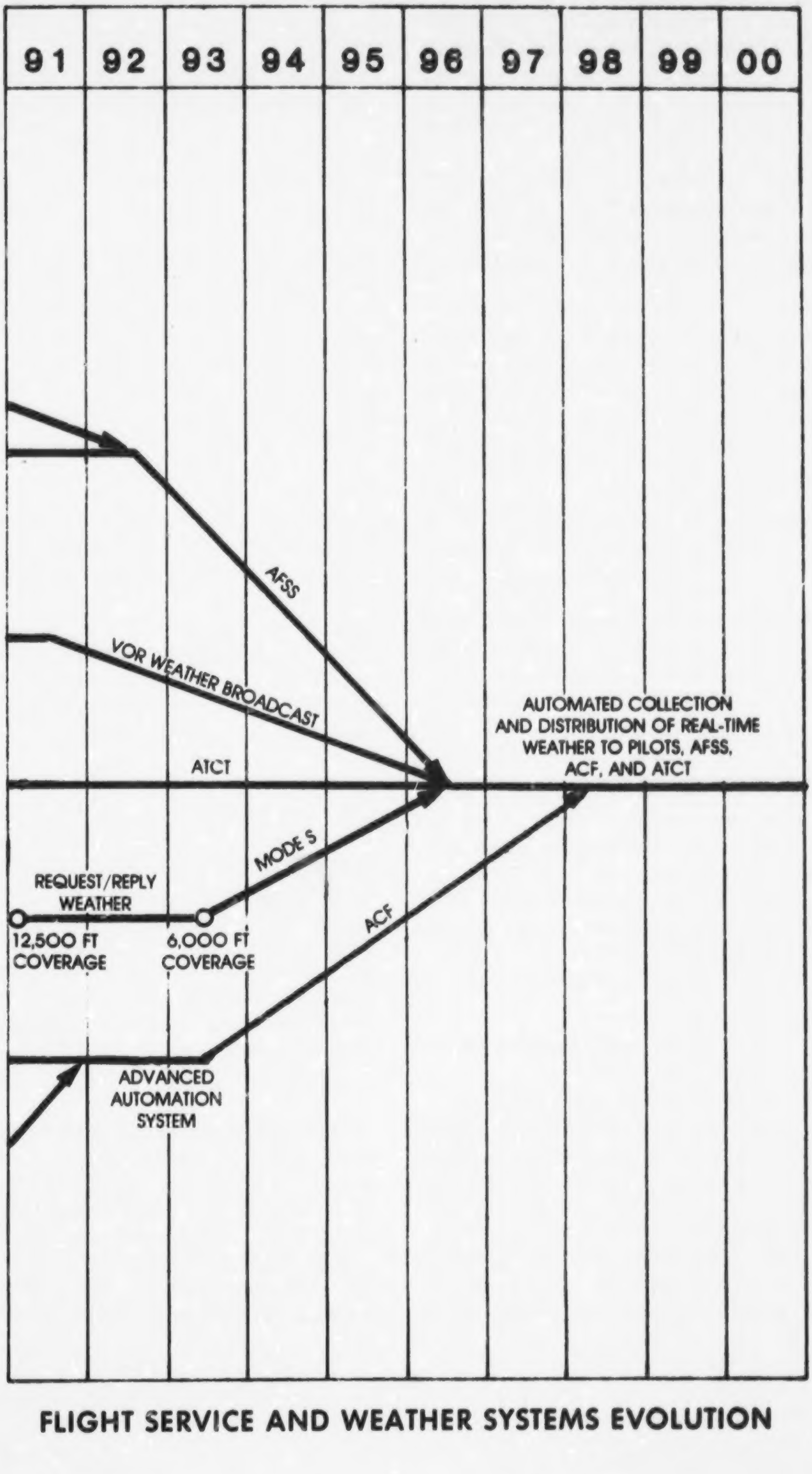
CENTRAL
WEATHER
PROCESSOR



FLIGHT SERVICE AND WEATHER SYSTEMS EVOLUTION

GROUND-TO-AIR

Ground-to-air systems include equipment which provides surveillance, communications, navigation, and landing-aid services.

The plan underscores four major themes related to the ground-to-air system:

- Facilities exclusive of landing systems, now numbering over 3,000, will be consolidated to 60 percent of that level through extensive co-location of systems.

- Consolidation and modernization of radar and communications facilities will lead to the establishment of integrated national networks providing the same coverage capability with a reduced number of separate facilities.

- Microwave landing systems (MLS) will replace instrument landing systems (ILS) and provide multiple, curved, and segmented approaches and selectable glide angles.

- A discretely addressable surveillance capability (Mode S) with an integral data link will replace the present ATC radar beacon interrogator systems at high-density terminals and en route surveillance sites.

The ground-to-air system will be based on a networking concept which provides nationwide service and coverage for surveillance, navigation, and voice and data link communications. The new networks will result in significant savings by reducing the number of systems and separate building requirements, centralizing maintenance work centers, and reducing operating costs. Adequate coverage will be assured from a specified height above mean sea level (msl) and above ground level (agl). In many areas, however, the systems within a given network will provide coverage at lower altitudes.

En route surveillance coverage will be provided down to 6,000 feet msl or minimum instrument flight rules altitude (whichever is higher) and to the surface of qualifying airports. The network is comprised of en route and terminal search and beacon systems. Department of Defense (joint surveillance site) requirements will be met by using a national perimeter of new three-dimensional minimally attended radar systems. Search radar will be retained for FAA weather and air traffic control requirements into the 1990's. Weather detection provided by en route search radar will gradually be replaced by the next generation weather radar (NEXRAD).

By 1990, Mode S and data link coverage will be provided down to 12,500 feet msl and to the surface at designated airports. Mode S and data link coverage by the year 2000 will be extended down to 6,000 feet msl.

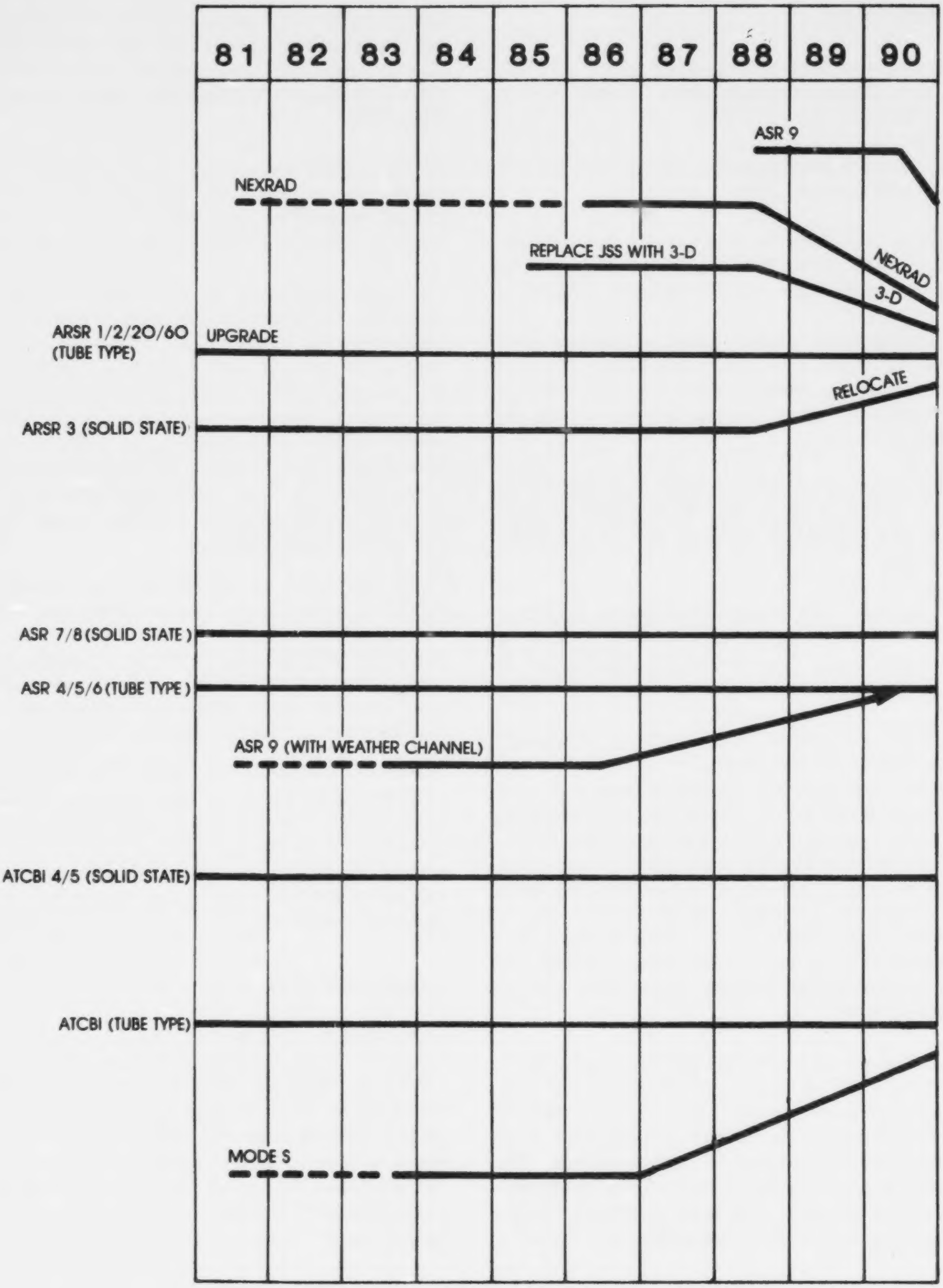
En route navigation will be provided down to 2,000 feet above terrain. Existing very high frequency omnidirectional ranges (VOR), VORs co-located with tactical air navigation (VORTAC), and VOR/distance measuring equipment (DME) will be replaced through the existing project for second-generation VORTACs and VOR/DMEs. The direction finder sensor network will be expanded to provide additional emergency assistance to pilots. Nondirectional beacons (H and HH facilities) will be added in a limited number for new navigation qualifiers only.

A limited number of solid-state ILS components are being installed to meet maintainability requirements. No ILS establishments are planned beyond FY–84. MLS implementation will begin in 1986. Installation rates of 100 systems per year will be achieved by 1988 and continue until 1,250 systems are implemented. The replacement of ILS by MLS will be gradual.

En route and flight service station (FSS) voice communications coverage will be provided down to 2,000 feet above terrain. Terminal voice communications will be provided to the surface at designated airports. Existing and future radiofrequency requirements will make conversion of ground and airborne systems to 25 kHz spacing necessary.

CONSOLIDATION

Consolidation of identical voice communications equipment into common buildings or with other compatible facilities will provide significant operations cost-savings. Remote communications facilities for towers, centers, and FSSs will be consolidated and some co-located with VOR/DME or en route surveillance facilities. As a result, the number of independent communication facilities, buildings, and property leases can be reduced substantially.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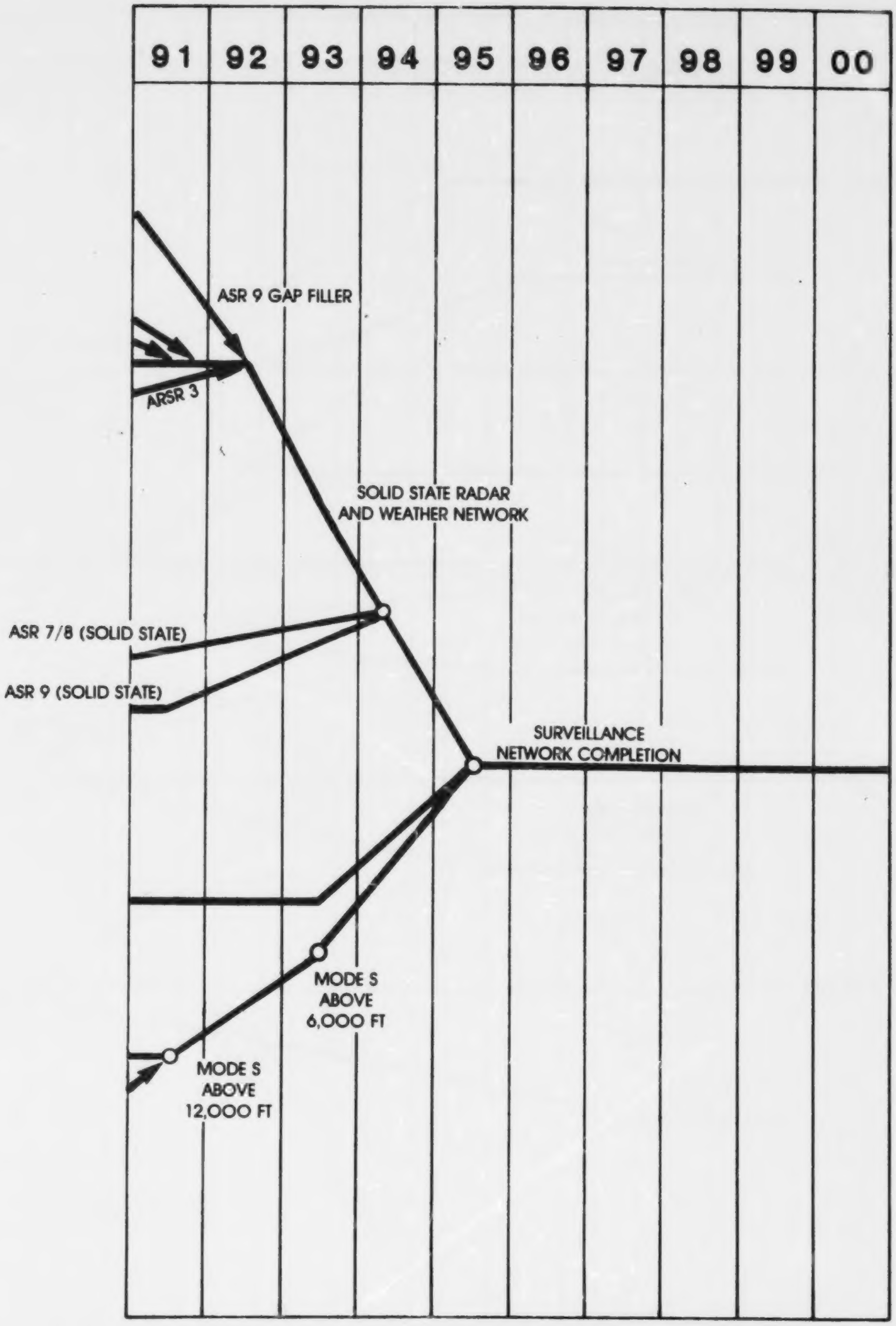
ASR 9
NEXRAD
REPLACE JSS WITH 3-D
NEXRAD
3-D
ARSR 1/2/20/60 (TUBE TYPE)
UPGRADE
RELOCATE
ARSR 3 (SOLID STATE)
ASR 7/8 (SOLID STATE)
ASR 4/5/6 (TUBE TYPE)
ASR 9 (WITH WEATHER CHANNEL)
ATCBI 4/5 (SOLID STATE)
ATCBI (TUBE TYPE)
MODE S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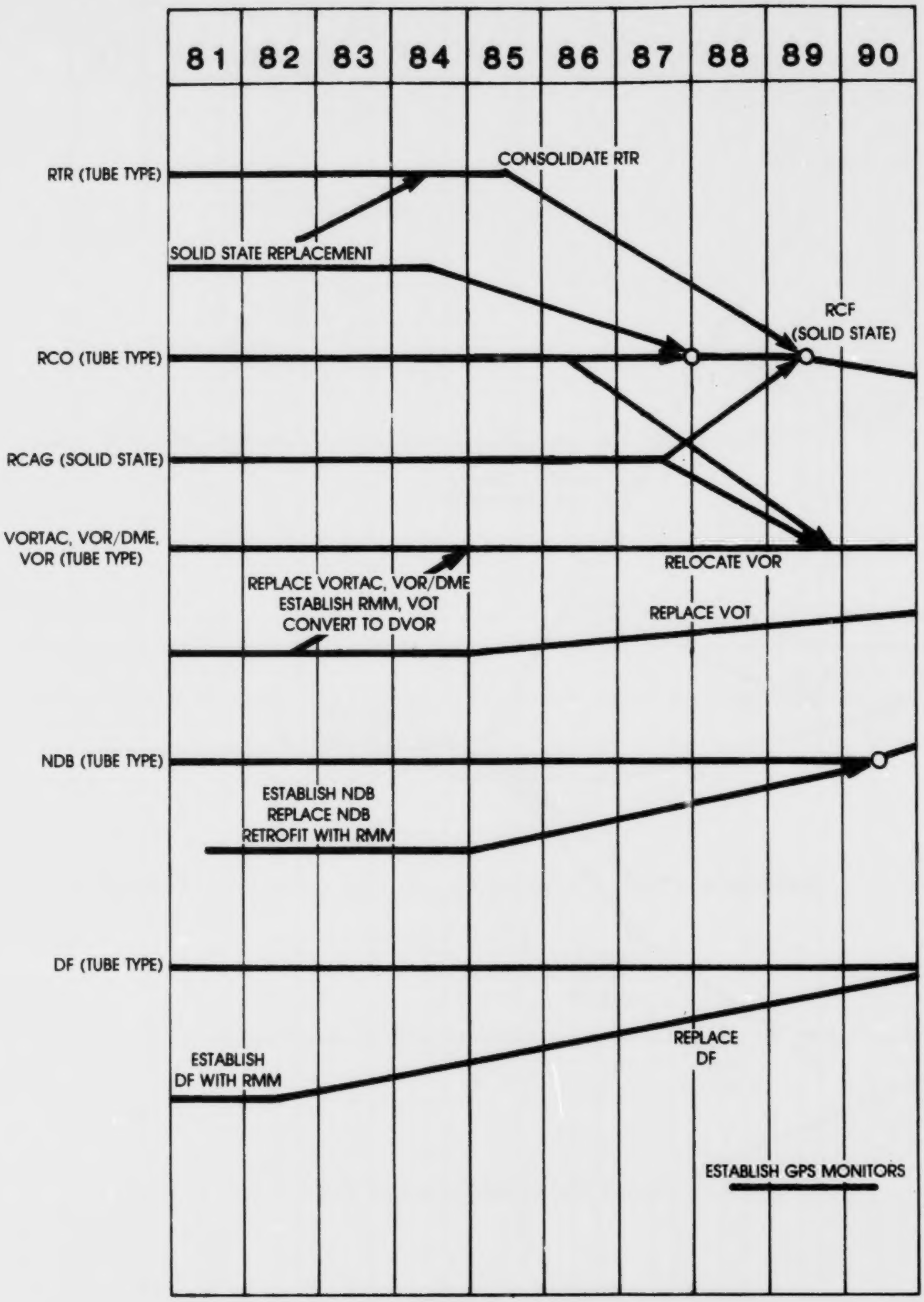
ASR 9 GAP FILLER
ARSR 3
SOLID STATE RADAR AND WEATHER NETWORK
ASR 7/8 (SOLID STATE)
ASR 9 (SOLID STATE)
SURVEILLANCE NETWORK COMPLETION
MODE S ABOVE 6,000 FT
MODE S ABOVE 12,000 FT

SURVEILLANCE SYSTEMS EVOLUTION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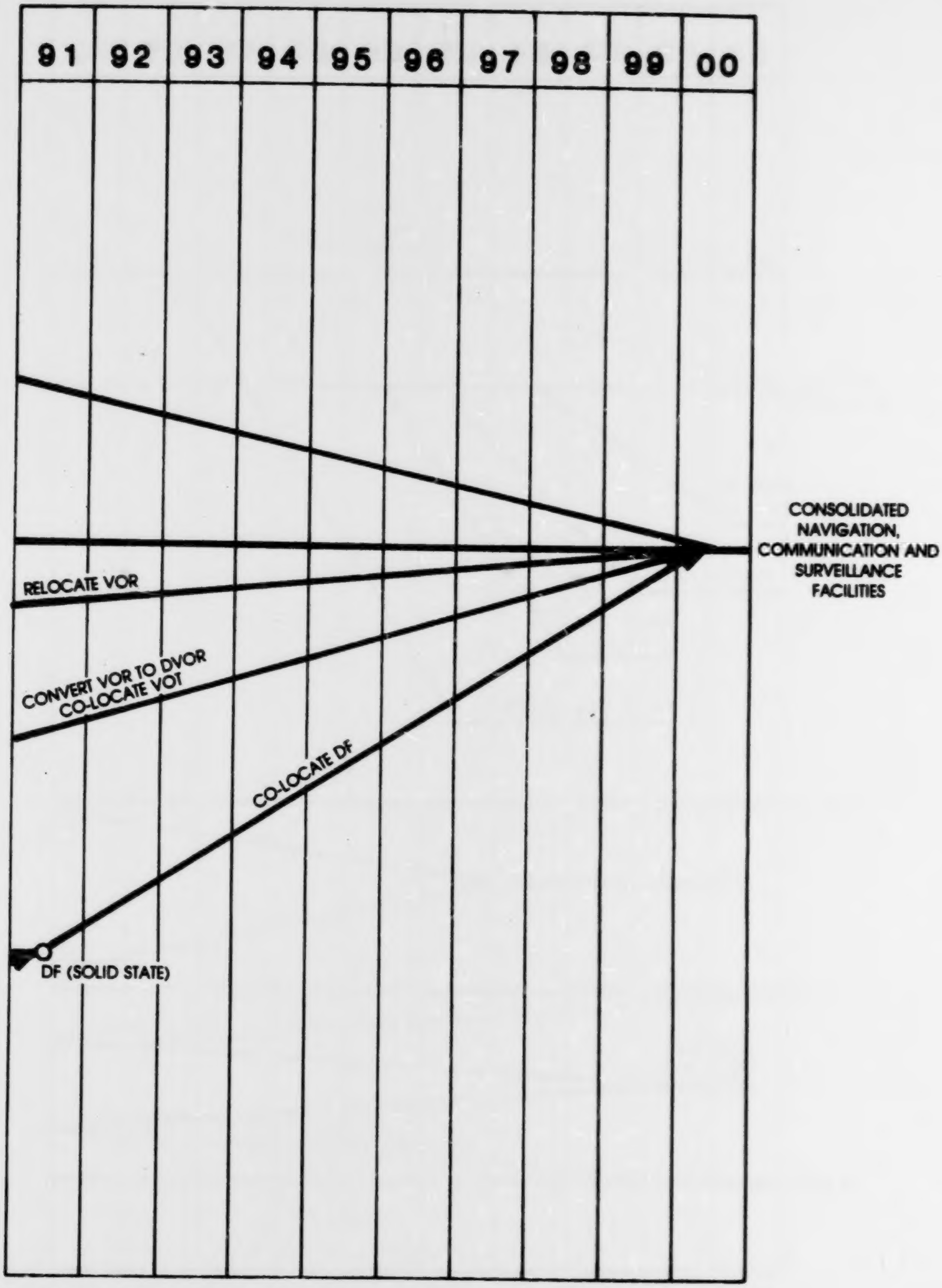
RTR (TUBE TYPE)
CONSOLIDATE RTR
SOLID STATE REPLACEMENT
RCF
(SOLID STATE)
RCO (TUBE TYPE)
RCAG (SOLID STATE)
VORTAC, VOR/DME,
VOR (TUBE TYPE)
RELOCATE VOR
REPLACE VORTAC, VOR/DME
ESTABLISH RMM, VOT
CONVERT TO DVOR
REPLACE VOT
NDB (TUBE TYPE)
ESTABLISH NDB
REPLACE NDB
RETROFIT WITH RMM
DF (TUBE TYPE)
ESTABLISH
DF WITH RMM
REPLACE
DF
ESTABLISH GPS MONITORS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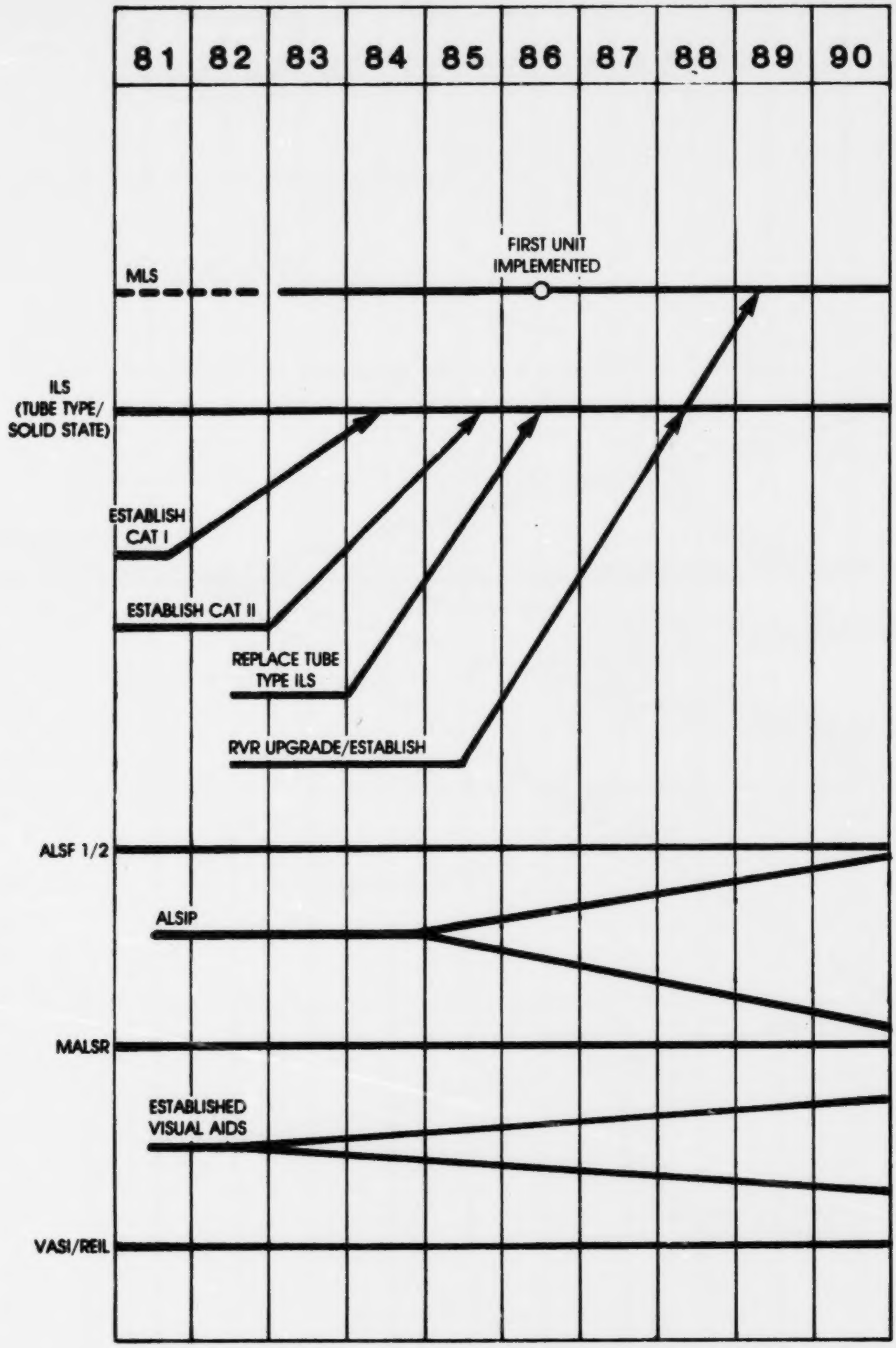
RELOCATE VOR
CONVERT VOR TO DVOR
CO-LOCATE VOT
CO-LOCATE DF
DF (SOLID STATE)
CONSOLIDATED NAVIGATION, COMMUNICATION AND SURVEILLANCE FACILITIES

NAVIGATION AND COMMUNICATIONS SYSTEMS EVOLUTION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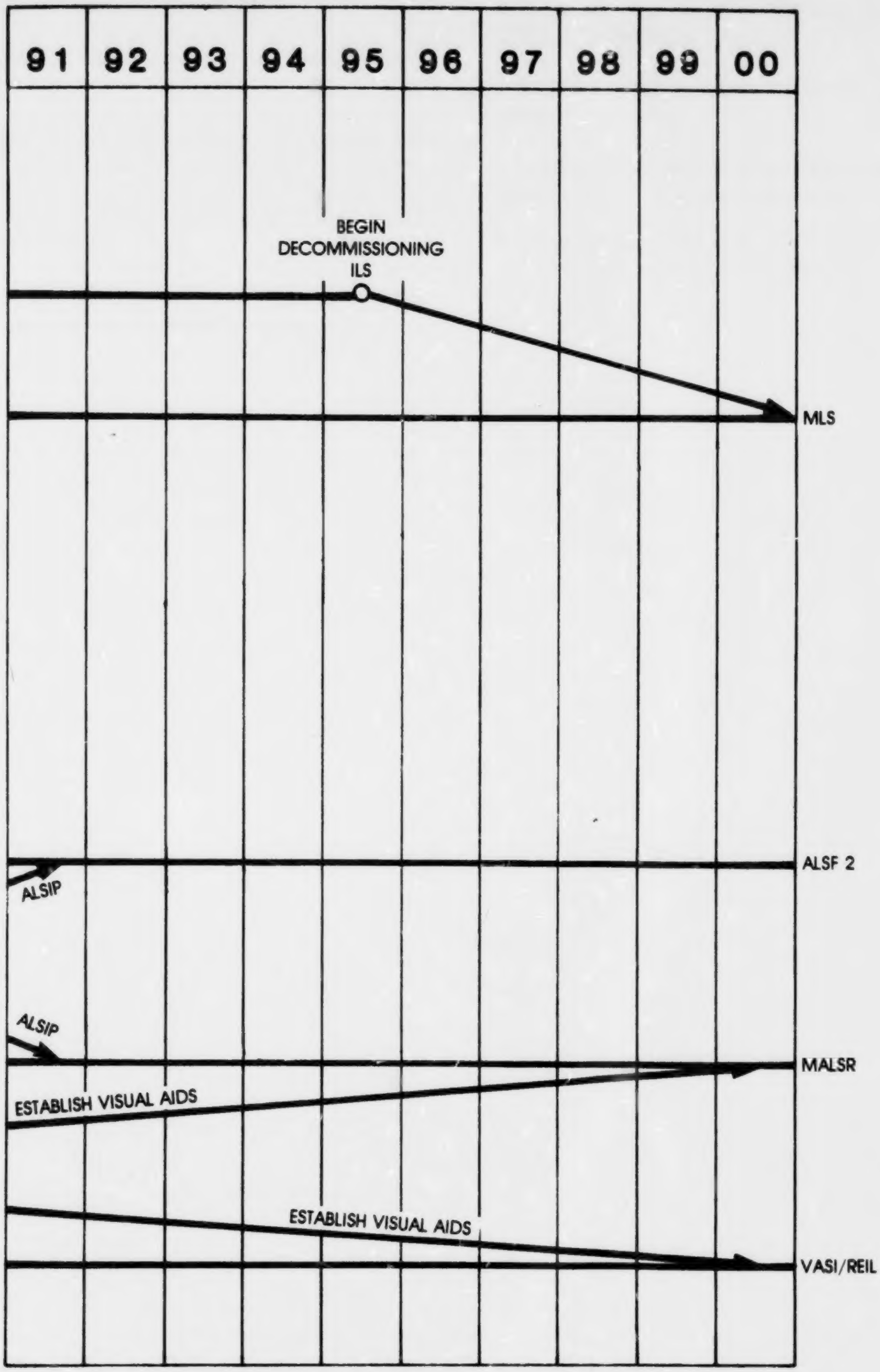
FIRST UNIT IMPLEMENTED
MLS
ILS (TUBE TYPE/ SOLID STATE)
ESTABLISH CAT I
ESTABLISH CAT II
REPLACE TUBE TYPE ILS
RVR UPGRADE/ESTABLISH
ALSF 1/2
ALSIP
MALSR
ESTABLISHED VISUAL AIDS
VASI/REIL

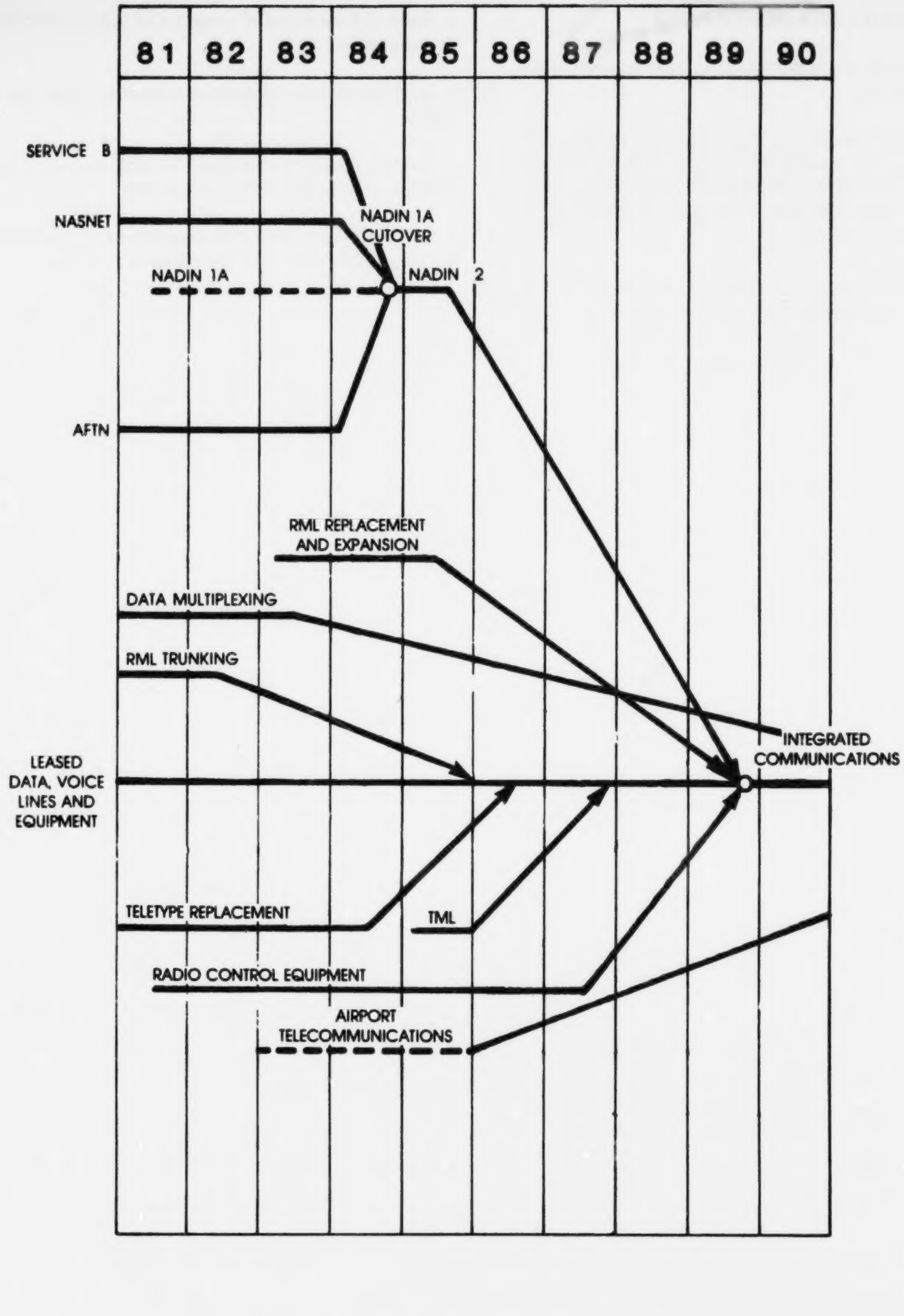


LANDING SYSTEMS EVOLUTION

INTERFACILITY COMMUNICATIONS

The key points in the plan relating to interfacility communications are:

- The system will be characterized by a reliable, efficient, integrated interfacility network. The network will use current-technology equipment, multiplexing, automatic switching, alternate routing, high-speed digital transfer, and trunking.
- The total network will provide communications systems at a significantly lower operating cost.
- There will be a mix of owned and leased switching and carrier facilities.
- Both terrestrial and satellite carrier facilities will be used.
- Existing microwave links will be replaced with highly reliable, low-maintenance equipment.
- Other elements within the Department of Transportation may potentially use the network.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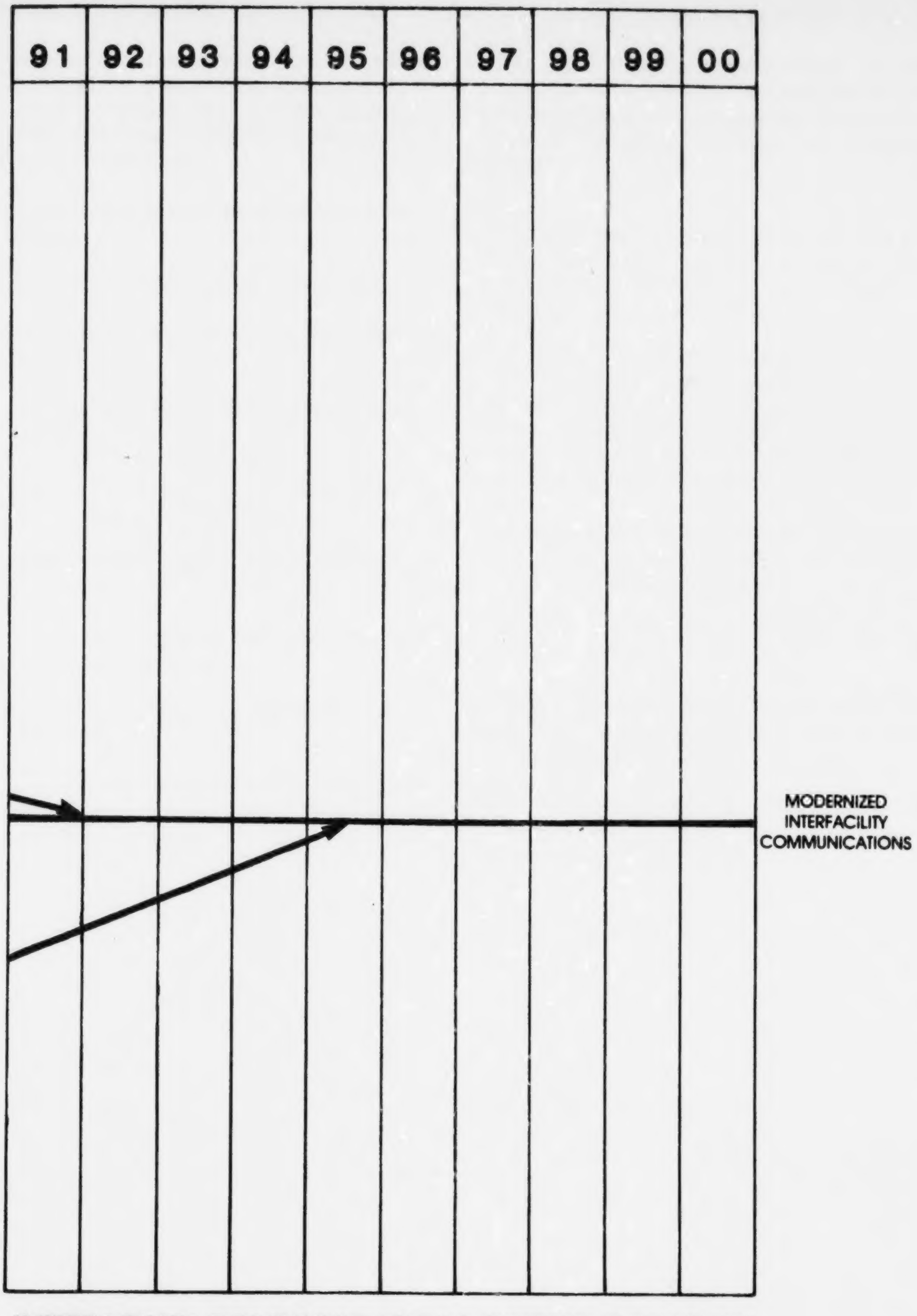
SERVICE B
NASNET
NADIN 1A CUTOVER
NADIN 1A
NADIN 2
AFTN
RML REPLACEMENT AND EXPANSION
DATA MULTIPLEXING
RML TRUNKING
INTEGRATED COMMUNICATIONS
LEASED DATA, VOICE LINES AND EQUIPMENT
TELETYPE REPLACEMENT
TML
RADIO CONTROL EQUIPMENT
AIRPORT TELECOMMUNICATIONS



INTERFACILITY COMMUNICATIONS SYSTEMS EVOLUTION

MAINTENANCE AND OPERATIONS SUPPORT

These systems refer to those equipment processes and services required to support the operations of the National Airspace System. They comprise such programs as flight inspection, facility maintenance, power systems, and plant facilities.

Airway facilities maintenance costs will be substantially reduced through:

- Consolidation of work centers and manned facilities.
- Lower staffing levels made possible by remote maintenance monitoring.
- Lower support costs for FAA-owned housing and plant facilities.
- Improved field training via computer-based instruction.

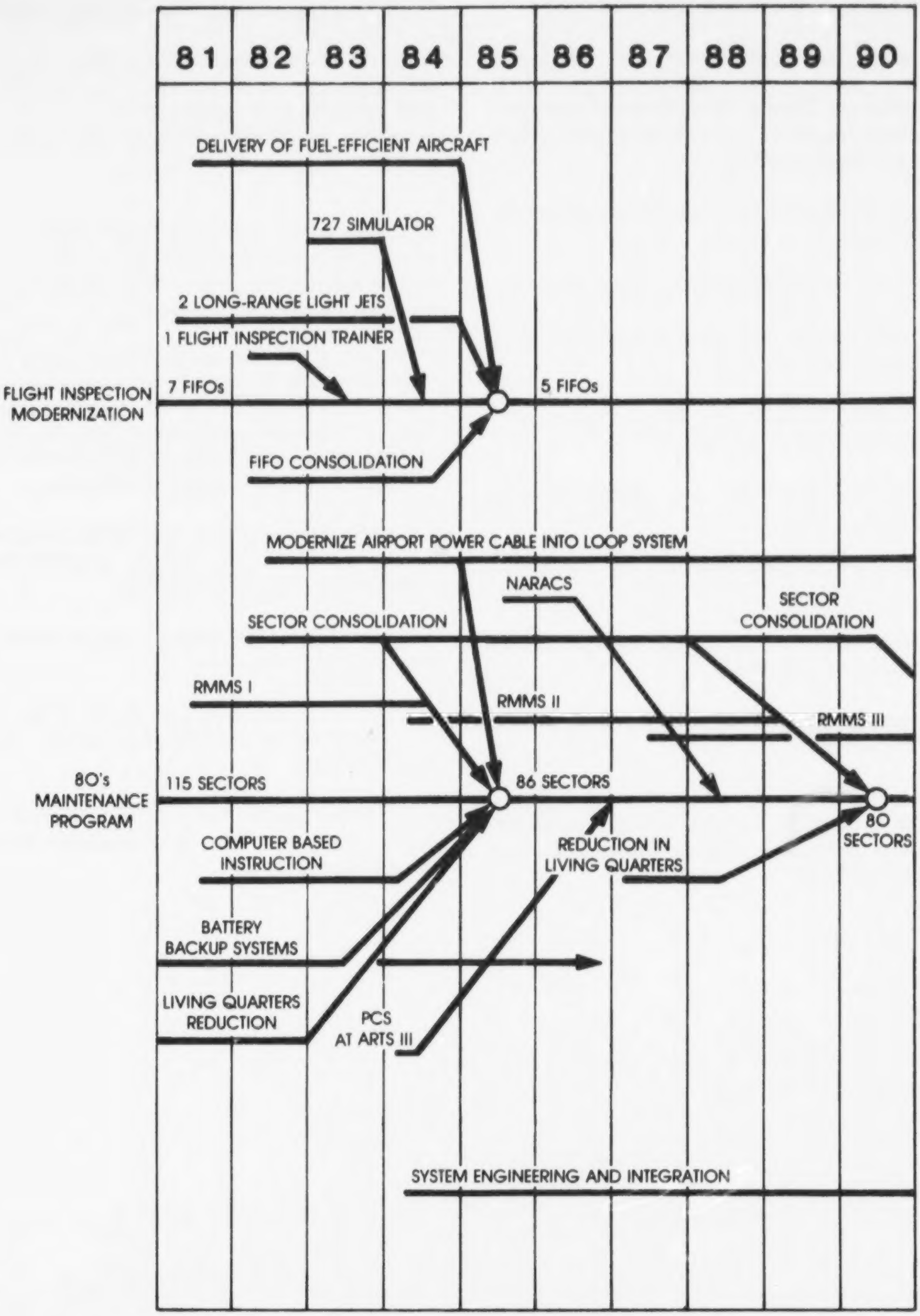
Flight inspection expenditures will be decreased through:

- Reductions in the number of flight inspection field offices through consolidation.
- Reductions in flight inspection, aircraft flight time, and fuel consumption.

The objective is to provide improved services at less operational costs by modernizing the flight inspection program and by implementing the Maintenance Program for the 1980's.

The following is representative of these programs:

- The flight inspection modernization program replaces the current aircraft fleet with fuel-efficient aircraft, provides an automated flight inspection system, upgrades associated services, and improves the process.
- The Maintenance Program for the 1980's is a significant commitment to modify maintenance practices and consolidate the location of work stations, thereby, reducing staffing requirements.
- The use of remote maintenance monitoring equipment to monitor equipment performance will change maintenance practices and eliminate the need to staff many of the presently manned facilities. As a result, the number of manned facilities will decrease from the present 1,000 facilities to approximately 300.
- Existing labor-intensive vacuum-tube systems will be replaced by highly reliable, cost-effective, low-maintenance, solid-state systems.
- Modernization of facilities will provide significant energy savings.
- Labor-intensive engine generators will be replaced by battery backup systems as a result of solid-state implementation.
- The above improvements will eliminate the need for costly government housing and support services at certain remote areas.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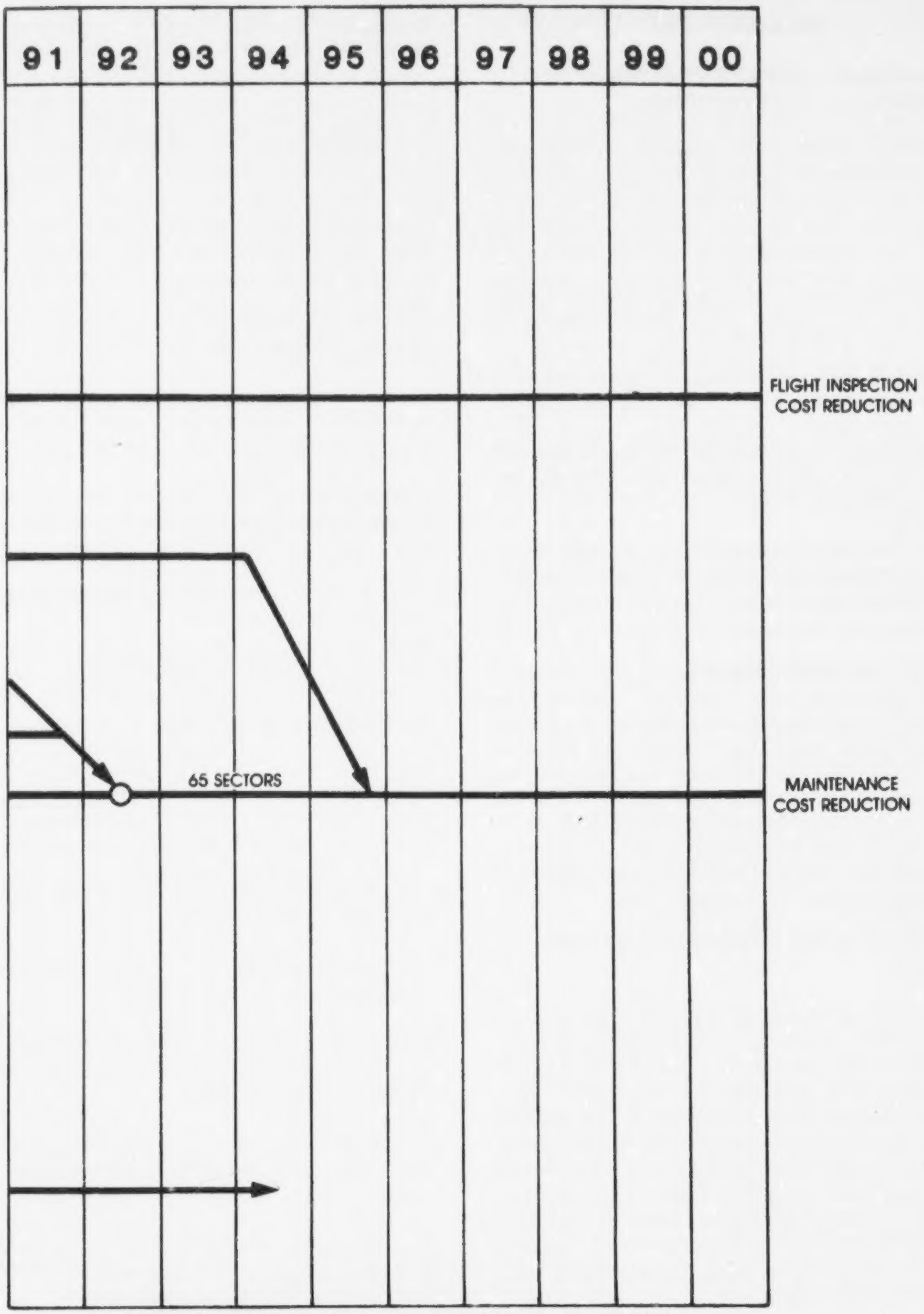
DELIVERY OF FUEL-EFFICIENT AIRCRAFT
727 SIMULATOR
2 LONG-RANGE LIGHT JETS
1 FLIGHT INSPECTION TRAINER
FLIGHT INSPECTION MODERNIZATION
7 FIFOs
5 FIFOs
FIFO CONSOLIDATION
MODERNIZE AIRPORT POWER CABLE INTO LOOP SYSTEM
NARACS
SECTOR CONSOLIDATION
SECTOR CONSOLIDATION
RMMS I
RMMS II
RMMS III
80's MAINTENANCE PROGRAM
115 SECTORS
86 SECTORS
80 SECTORS
COMPUTER BASED INSTRUCTION
REDUCTION IN LIVING QUARTERS
BATTERY BACKUP SYSTEMS
LIVING QUARTERS REDUCTION
PCS AT ARTS III
SYSTEM ENGINEERING AND INTEGRATION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FLIGHT INSPECTION COST REDUCTION
65 SECTORS
MAINTENANCE COST REDUCTION

MAINTENANCE AND OPERATIONS SUPPORT SYSTEMS EVOLUTION

RELATED PLANS

THE NATIONAL AIRSPACE PLAN FOR ENGINEERING AND DEVELOPMENT

The FAA is funding many development projects in areas such as airborne, helicopter, airports, and regulatory programs which are accomplished at various R&D facilities. These facilities also test, evaluate, and support F&E fielded systems throughout their life cycle. The plan is organized into three major chapters supporting the evolution of the system beyond the year 2000. These three chapters are:

- **NAS Modernization.** The R&D programs required to support implementation of the NAS Plan for F&E.

- **Aviation User Improvements.** Projects supporting other aspects of the aviation community, such as safety and regulatory activities.

- **Advanced NAS Applications.** Projects leading to realization of long-term goals of the FAA where the technological direction and specific means for accomplishment are not as well defined.

ROTORCRAFT MASTER PLAN

The agency's Rotorcraft Master Plan defines the requirements and associated research and development efforts relating to producing facilities, airborne equipment, and procedures designed to solve the specific problems encountered by rotorcraft. These efforts will build upon the systems used for fixed-wing aircraft. Results will provide a cost-effective approach to meet the needs of both aviation users.

NATIONAL PLAN OF INTEGRATED AIRPORT SYSTEMS

The National Plan of Integrated Airport Systems is the airport planning counterpart to the National Airspace System Plan and will interface with the facility and equipment and engineering and development programs. The National Plan of Integrated Airport Systems will be the successor to the National Airport System Plan. It will contain the requirements for airport development and detail the capital needs for improvement of the state and local government-owned airport components of the National Airspace System. The National Plan of Integrated Airport Systems is scheduled to be published by September 1984.

THE NATIONAL AIRSPACE REVIEW

The National Airspace Review (NAR) is a cooperative effort between government and industry to improve the safe and efficient use of the nation's airspace.

The National Airspace System Plan spells out the improvements needed to safely meet the projected demands on air transportation between now and the year 2000. The National Airspace Review is one component of the Plan, focusing on airspace and procedural aspects of the air traffic control system and making recommendations for improvement. To accomplish this, the NAR is conducting an in-depth study of ATC procedures to promote greater efficiency for all users, simplify the ATC system, match airspace and procedures to technological improvements in fuel-efficient programs, and eliminate, wherever possible, governmental constraints. The work of the NAR is expected to be completed in late 1984.

RESULTS OF THE PLAN

MAJOR DECISIONS

In conjunction with the planning process, FAA has made a series of major decisions which serve as the keystones of the system plan:

- The air traffic control system will continue to be fundamentally ground-based.

- TCAS I and TCAS II (traffic alert and collision avoidance system) will be independent airborne backups to the air traffic control system.

- A major computer/data processing system (including a new sector suite and new system software) will be procured. The new system will support en route and terminal functions and allow for consolidation.

- The highest practical level of air traffic control automation will be implemented.

- A modernized traffic flow management process will be implemented.

- Secondary surveillance radar (SSR) Mode S, with its integral data link, will replace the air traffic control radar beacon system (ATCRBS).

- En route search radar may be phased out by the year 2000. However, terminal primary radar with a weather channel will continue to be required.

- A new weather radar network will be provided for the air traffic control system. It will include NEXRAD and a terminal radar weather channel (ASR–9).

- FAA will proceed with upgrading ARTS II and ARTS III (automated radar terminal system).

- A major improvement and integration of the FAA communications system will be implemented.

- The automated flight service station system will be implemented, along with a major improvement in weather services to users.

- Direct automated pilot access to weather information will be provided. Automated weather observation systems will supplement or replace human observers.

- The instrument landing system (ILS) will be supplemented with, and then replaced by, the microwave landing system (MLS).

- Work will continue on improvement of airports themselves, as well as on higher airport/terminal capacity.

- FAA will proceed with extensive consolidation of facilities and the removal of the impact of artificial system boundaries on users.

- A major system engineering and integration contractor will be obtained to assist the FAA in the accomplishment of the NAS Plan.

IMPLICATIONS FOR USERS

As a result of the planned actions, users will be the beneficiaries of the following improvements:

- Increased safety through collision avoidance and improved weather information.

- Reduced delays.

- Reduced fuel consumption.

- Increased pilot-preferred routing.

Although no additional equipage will be required for most new services, there will be some—especially for TCAS, Mode S/data link, microwave landing system (MLS), and 25 kHz communications.

Costs for all of these will be borne by the user.

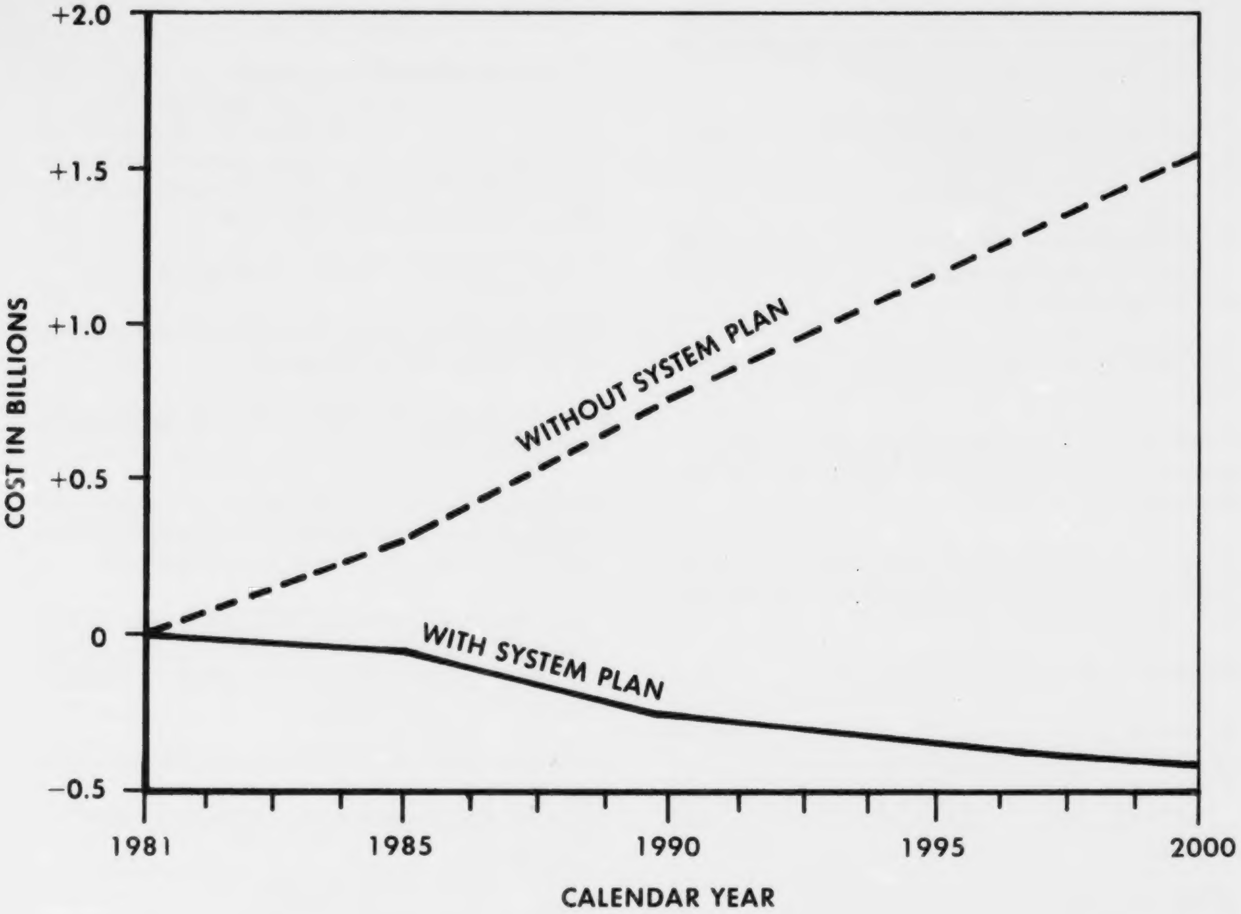
The following new requirements are anticipated to permit full participation in the system:

- ILS will be supplemented with, and subsequently replaced by, MLS.

Airborne equipment will be needed to use this new service, with the need for a number of aircraft to carry dual ILS/MLS avionics during the transition.

- It is expected that after 1986, pilots who wish to receive full ATC service in all controlled airspace will need 720-channel VHF communications capability in their aircraft.

- While this plan does not anticipate mandatory carriage of Mode S or TCAS, it is expected that there will be widespread implementation of these systems.



CHANGE IN ANNUAL AIR TRAFFIC AND AIRWAY FACILITIES OPERATIONS COSTS

RETURN ON THE INVESTMENT

The implementation of the plan is expected to have the following results:

CAPABILITY

The resulting system will provide for planned, conflict-free, fuel-efficient flight paths. Safety will be improved by reducing system errors. Flight paths desired by airspace users will be accommodated on a regular basis. The growing demand of flight operations will be accommodated with a minimum of constraint and with the highest practical fuel efficiency. Dynamic flow management will reduce airborne delays.

Pertinent and timely current weather information will be available to both the pilot and controller.

Reduced maintenance requirements will allow more efficient use of maintenance personnel.

EQUIPMENT BASE

Automation, navigation, surveillance, and landing system equipment will employ up-to-date technology. Like functions will utilize like equipment. A national network of facilities based on actual demand patterns and maintenance requirements will be in place. An efficient communications network will support individual facilities.

CONSOLIDATION

Fewer major manned control facilities will be required. Remote facilities will also be consolidated. Unique facilities as well as unique equipment types will be eliminated. The consolidation of facilities will reduce overhead costs. The logical grouping of compatible services using standardized communications, computer, and display elements, where practicable, will achieve efficiency and economy.

COST SAVINGS

The plan will achieve improved cost-effectiveness of the National Airspace System. Savings to users will result from reduction in delays; improved fuel-efficient, pilot-preferred routing; and fewer opportunities for accidents.

In addition, savings in system operations and maintenance costs in the improved system, as compared to the "1981 equivalent" system, will be $4.6 billion from 1981 through 1990 and $19.9 billion from 1981 through the year 2000.

CONCLUSION

This plan identifies the capital investment required to modernize and consolidate the air traffic control system, the major R&D and F&E programs to accomplish it, the strategy to carry it out, and the major decisions facing the Administration to ensure its success. The plan will:

- Permit the evolution of the system from a segregated (en route, terminal, etc.) to an integrated system.
- Ensure no degradation or loss of existing services.
- Improve services where deficiencies exist.
- Accommodate increasing traffic levels and demands for services achievable within the physical limitations of the system.
- Reduce future staffing levels and operations and maintenance costs.

Implementing the plan will be expensive and will proceed more slowly than many would wish. However, the sheer magnitude of the test, along with the technological innovations required to avoid early obsolescence, and the need to constrain expenditures in the nation's interest makes the plan practicable.

The plan requires consistent funding in order to be executed efficiently. There will be continuous Executive and Legislative oversight, of course; but, a continuing commitment to the funding levels is necessary to execute the plan.

CHAPTER II

DEMAND ON THE SYSTEM

DEMAND ON THE SYSTEM

The United States National Airspace System is the busiest and most complex in the world. The airspace accommodates over 237,000 active civil and military aircraft. Performance characteristics of these aircraft vary widely and the missions flown have differing impacts on the system. The overall trend is toward the production of more sophisticated aircraft which make greater use of controlled airspace and the services which FAA provides.

The continuing growth in the number of aircraft operations, diversity of operations, number of aircraft, and sophistication of aircraft will place unprecedented demands on the National Airspace System from now through the turn of the century. The safe and efficient operation of the National Airspace System will require improved services, new facilities for system expansion and the orderly replacement of aging facilities, and the provision of adequate airport capacity.

Despite its high level of safety, the National Airspace System is not without difficulties. Energy costs will be a continuing problem, and greater fuel efficiency will remain a major goal. Problems of expanding capacity at congested airports, the provision of more direct routings, and the accommodation of greater numbers of sophisticated aircraft must be dealt with effectively.

GENERAL SYSTEM DEMAND

Forecasts indicate that demand in terms of aviation activity will more than double in the next two decades. Table I depicts the growth anticipated in aviation demand highlighting the years 1982, 1985, 1990, and 2000.

OPERATIONS AND ENPLANEMENTS

Aircraft operations, including takeoffs and landings at all towered and nontowered airports in the National Airport System Plan (NASP), the forerunner to the National Plan of Integrated Airport Systems (NPIAS), are anticipated to grow by 100 percent over the next 18 years, with itinerant operations also increasing 100 percent. A breakdown of aircraft operations for the different types of civil airports can also be found in Tables II and III. Table IV provides information concerning military-owned and -operated airports. Instrument operations—including each time that separation is provided in a terminal area by an air route traffic control center (ARTCC) or FAA terminal approach facility (an indicator of terminal instrument flight rules (IFR) operations)—will increase by 84 percent. En route IFR aircraft handled (an indicator of ARTCC operations) will increase by 72 percent. Flight service station (FSS) operations, including pilot briefings, flight plan origination, and aircraft contacted, will grow by 62 percent. Domestic enplanements include all enplanements for the activity indicated, regardless of airport type. Air carrier domestic enplanements are expected to increase by 119 percent and commuter enplanements by 243 percent.

AIRCRAFT HOURS, FLEET, AND PILOTS

Air carrier hours flown are forecast to increase 54 percent, general aviation 73 percent, and military 26 percent. The number of air carrier aircraft will increase by 36 percent, commuter aircraft by 94 percent, general aviation by 51 percent, and the helicopter fleet by 77 percent. Growth of 27 percent is anticipated in the military fleet.

The mix of the general aviation fleet will be altered dramatically during this period. The single-engine piston fleet, which normally operates visual flight rules (VFR) below 12,000 feet, will increase from 168,000 to 240,000 aircraft. The more sophisticated twin-engine and turbine-powered aircraft will comprise the fastest growing segment of the fixed-wing fleet, increasing from 33,000 to 55,000 aircraft. The number of pilots will increase by 40 percent, and those with instrument ratings will grow by 68 percent.

MILITARY AVIATION REQUIREMENTS

Response to military requirements places special demands on the National Airspace System particularly in en route airspace. The FAA also provides approach control services for over half of the 233 military airfields in the United States. This service is in addition to over 50 approach control facilities and 180 control towers that are operated by the military service. The Department of Defense operates over 21,000 aircraft within the National Airspace System, flying approximately 6 million hours a year. Over 90 percent of this flying is dedicated to training missions. These training missions include high-speed maneuvering flight in all altitude bands, with increasing need for very low-level operations. Increased air refueling activity, air drop missions, and frequent large-scale joint exercises require close coordination with civil traffic flows. The increased speed, range, and capabilities of military flight operations also indicate that a higher level of demand will be placed on the National Airspace System for training and testing, even though the total number of military aircraft will remain relatively constant. A relatively small amount of airspace is reserved exclusively for military use. Therefore, there will be a need for continued coordination and improved navigation and air traffic control service as growing civil aviation and military aviation requirements must be accommodated within common airspace.

TABLE I. TOTAL NATIONAL AIRSPACE SYSTEM ACTIVITY

	1982	1985	1990	2000	Percent Growth 1982-2000
Existing and Projected Airports	3195	3400	3638	4000	25.2
Airport Operations (millions)					
Aircraft Operations	127.6	155.8	185.8	255.3	100.1
Itinerant Operations	68.0	81.1	98.2	136.1	100.1
Instrument Operations	31.6	39.4	46.6	58.0	83.5
Towered Airport Operations	61.6	61.4	83.4	105.6	71.4
ARTCC Operations (millions)					
IFR Aircraft Handled	27.8	32.1	37.4	47.8	71.9
ACF Approach Control Operations	—	—	—	58.0	—
FSS Services (millions)	62.4	64.2	80.6	101.0	61.9
Hours Flown (millions)					
Air Carrier	6.3	6.8	7.5	9.7	54.0
General Aviation	37.8	39.1	49.6	65.4	73.0
Military	6.2	6.5	7.2	7.5	21.0
Domestic Enplanements (Revenue Passenger) (millions)					
Air Carrier	272.8	330.0	409.0	598.5	119.4
Commuter	17.1	23.4	33.6	58.6	242.7
Aircraft Fleet (thousands)					
Air Carrier	2.5	2.6	2.9	3.4	36.0
Commuter*	1.8	2.0	2.4	3.5	94.4
General Aviation Total	213.2	211.0	251.8	321.9	51.0
Civil Helicopter*	7.0	7.2	8.7	12.4	77.1
Military Total	21.7	21.8	23.3	24.5	12.9
Military Helicopter*	9.7	9.7	10.3	10.8	11.3
Pilots (thousands)					
Instrument Rated	252.5	274.3	327.3	422.8	67.5
Total Pilots	764.2	761.2	888.7	1070.7	40.1

*Civil Helicopter and Commuter Fleets are included in the Total General Aviation Fleet. Military Helicopter Fleet is included in Total Military Fleet.

TABLE II. COMMERCIAL SERVICE AIRPORT ACTIVITY

	1982	1985	1990	2000	Percent Growth 1982-2000
Large Commercial*					
Airports	24	25	26	27	12.5
Operations (millions)	8.2	10.1	11.3	12.1	47.6
Enplanements** (millions)	196.3	266.7	320.7	446.6	127.5
Based Aircraft (thousands)	2.4	2.5	2.5	2.6	8.3
Other Commercial***					
Airports	545	574	592	623	14.3
Operations (millions)	53.8	71.1	88.2	125.1	132.5
Enplanements** (millions)	112.7	120.3	158.9	250.0	121.8
Based Aircraft (thousands)	61.0	65.1	80.7	104.3	71.0

*Airports at which over 1 percent of total U.S. passengers are enplaned.

**Includes scheduled and nonscheduled traffic by domestic and foreign flag carriers, commuters, and air taxis.

***Airports receiving regularly scheduled service when 2,500 or more passengers are enplaned annually (excludes large commercial airports).

TABLE III. GENERAL AVIATION AIRPORT ACTIVITY

	1982	1985	1990	2000	Percent Growth 1982-2000
Reliever Airports					
Airports	202	230	260	300	48.5
Operations (millions)	20.0	21.4	26.2	35.7	78.5
Based Aircraft (thousands)	44.3	53.3	64.3	80.6	81.9
Other Airports					
Airports	2424	2571	2760	3050	25.8
Operations (millions)	45.6	53.2	60.1	82.4	80.7
Based Aircraft (thousands)	67.9	73.7	94.9	113.1	66.6

TABLE IV. MILITARY AIRPORTS

	1982	1985	1990	2000	Percent Growth 1982-2000
Airports	233	233	233	233	0
Operations (millions)	24.7	26.7	28.6	30.5	23.5
Military Operations	21.7	23.1	24.3	25.5	17.5
Civil Operations	3.0	3.5	4.3	4.6	53.0

AIRPORTS IN THE UNITED STATES

There are almost 16,000 landing areas in the United States, of which about 6,200 are open to the public.

The nation's most important civil airports (both public and privately owned) are included in FAA's National Airport System Plan (NASP). One of the requirements for an airport to be eligible for aviation trust fund planning or development grants is that it be in the NASP. The NASP includes 780 air carrier and commercial service airports, 155 reliever locations, and 2,224 other general aviation airports.

The National Plan of Integrated Airport Systems (NPIAS) is slated to become the successor document to the NASP when it is issued in 1984. One of the features of the NPIAS will be its use of a revised system for categorizing airports. Airline deregulation, as well as the Airport and Airway Improvement Act of 1982, have eroded most of the original meaning from the expressions "air carrier airport" and "commuter airport." This chapter uses the term "commercial airport" to combine the two categories during this transition period.

OPERATIONS

Today, civil airports handle about 128 million aircraft operations and enplane well over 309 million passengers. They accommodate over 237,000 aircraft.

Airport development is largely the responsibility of state and local governments. The Federal Government participates in development at the request of state and local governments through its airport grant program and encourages airport planning and development to enhance safety, reduce congestion, and protect the environment.

Airport activity will double by the year 2000. Accommodating this additional demand will be more difficult in the future than it has been in the past. Although most of the nation's airports will have adequate airside capacity through the turn of the century, many of our key metropolitan areas are now congested and many more are expected to become congested before the turn of the century. In many metropolitan areas, there is little or no reserve capacity and the potential for airside expansion is limited. Though only a relatively small percentage of airports are involved, they handle a disproportionately high percentage of scheduled passengers. The 24 largest commercial airports enplane approximately 64 percent of all passengers.

In nonmetropolitan areas, needed capacity may usually be obtained through conventional construction of runways and associated taxiways. Providing adequate aircraft tiedown and hangar facilities for the large number of additional general aviation aircraft expected to enter the system between now and the turn of the century will present a challenge to airport owners.

The basic methods for improvement in airport capacity fall into the following categories in congested areas:

- New airports.
- New or improved pavements at existing airports.
- Reduction in longitudinal (intrail) separation standards.
- Reduction in lateral separation standards (e.g., centerline separation between runways).
- Terminal area flow optimization.
- Reduction of runway occupancy time.

Construction of new airports and new or improved pavements at existing airports provide the largest incremental gains to capacity. To the extent possible, FAA is encouraging use of airport planning and development grants for capacity-related projects at airports that are now congested or are expected to be congested within the next decade.

Some increases in airport capacity will result from FAA's broad efforts to modernize the National Airspace System. Programs which have the potential to increase capacity or reduce delay include improved techniques for metering and controlling traffic flow, potential of converging instrument approaches, development of short parallel runways for smaller aircraft, reduced spacing between runways for independent instrument flight rules (IFR) operations, triple parallel instrument approaches, wake vortex detection, and the implementation of the microwave landing system.

Few, if any, major commercial hub airports are likely to be built in the near future. FAA's policy will be to continue to support local initiatives for the construction of new airports when they are a reasonable option to solving a congestion problem.

Establishing major new airports involves large financial, environmental, and land-use commitments. When the proposed new airport is to replace an existing airport, large economic dislocations are likely to result. It is for these reasons that metropolitan areas, when faced with overcrowded airports, seek alternatives to new construction. These alternatives can be broadly grouped as:

- Increasing the capacity and efficiency of existing airports.

- Encouraging the use of aircraft with greater seating capacity.

- Increasing the use of existing secondary airports within the hub.

Further increases in the capacity of existing airports are possible through conventional construction (such as new runways) when feasible, incorporation of new and improved technology into the air traffic control system and related areas, and use of improved and innovative air traffic control procedures. Delay at individual airports may also be reduced by local authorities through spreading and/or metering peak-hour traffic through regulatory or economic devices and encouraging the restructuring of airline service patterns so that connecting flights are not concentrated at a few large cities.

The second area for achieving increased capacity by employing large aircraft has been a key factor in accommodating growth for the past 20 years. The average seating capacity of large commercial aircraft has grown from less than 50 in 1950 to about 150 today. A significant part of projected passenger growth will continue to be absorbed through the use of larger aircraft. Adding more seats to existing aircraft and higher load factors will also contribute. Table II indicates that at large airports aircraft operations will increase at less than one-third the rate of passenger growth.

Increased use of secondary airports within the metropolitan area to accommodate system demand requires improving some reliever airports and constructing new reliever airports, as well as the more intensive use of an existing second or third airport for scheduled service.

The following map depicts the number of airports that are presently congested and forecasts numbers of airports that are expected to become congested through the turn of the century if additional capacity is not provided through new construction or implementation of capacity enhancing programs. Alleviation of congestion through demand reduction by either economic or regulatory means was not considered. Priority will be given to research and facilities projects which show promise of reducing congestion at airports. Priority will also be given under the airport grant program to projects which may alleviate congestion.

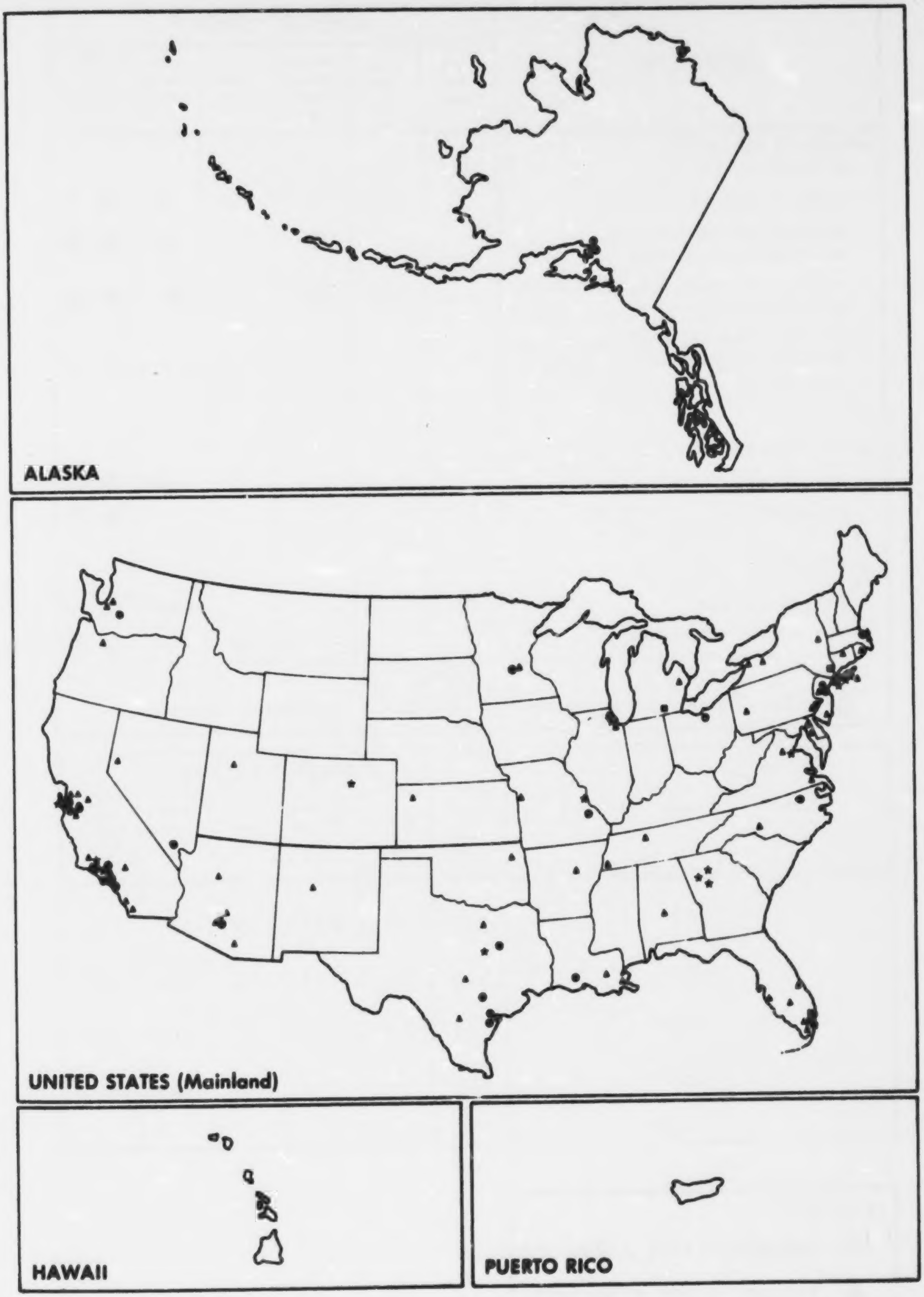
FUTURE REQUIREMENTS

Facilities and equipment, both federally and locally provided, will be needed in response to increases in demand, the provision of new or improved services, and the growth in numbers of airports. Figures associated with the following maps illustrate the anticipated distribution of airports, facilities, and equipment in four time frames: 1982, 1985, 1990, and 2000. Figures are provided for each airport type (commercial service, general aviation, and reliever).

The figures for each airport group show: (1) the growth in airport quantities and demographics and (2) the correlation of probability that particular services will be provided with respect to the various types of systems or equipment serving that type of airport. Airports that do not meet FAA benefit/cost criteria for approach guidance or air traffic control services may be provided facilities through non-Federal sources.

AIRPORTS TO EXPERIENCE SIGNIFICANT CONGESTION

	YEAR	COMMERCIAL	GENERAL AVIATION	TOTAL
★	1981	10	4	14
■	1985	15	7	22
●	1990	32	23	55
▲	2000	62	45	107


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

AIRSIDE CONGESTION AIRPORTS

EQUIPMENT	AIRPORT GROUP					
	NO FAA EQUIP	VISUAL AIDS ONLY	PRECISION APPROACH AIDS ONLY	TOWER ONLY	TOWER & PRECISION APPROACH AIDS	TOWER, RADAR SERVICE & PRECISION APPROACH AIDS
APPROACH GUIDANCE						
NON-FED VASI/REIL	◍					
FEDERALLY PROVIDED VASI/REIL		⊖	◓	◍	◍	● ◍
FEDERALLY PROVIDED MULTIPLE PRECISION APPROACH AIDS			●		◍	● ◍
FEDERALLY PROVIDED APPROACH LIGHTS (ALSF/MALS/SSALS)			⊖		◍	● ◍
FEDERALLY PROVIDED MULTIPLE PRECISION APPROACH AIDS (CAT I, II & III)						● ⊖
SEPARATION AND SEQUENCING						
AIRPORT TRAFFIC CONTROL TOWER				◍	◍	● ◍
RADAR SERVICE						● ◍
NAVIGATIONAL AIDS						
FED/NON-FED NDB	◍				⊝	● ⊖
FED/NON-FED VOR/VORTAC				⊝	◍	● ⊖

LARGE: ● CERTAIN; ◓ PROBABLE; ◒ POSSIBLE;

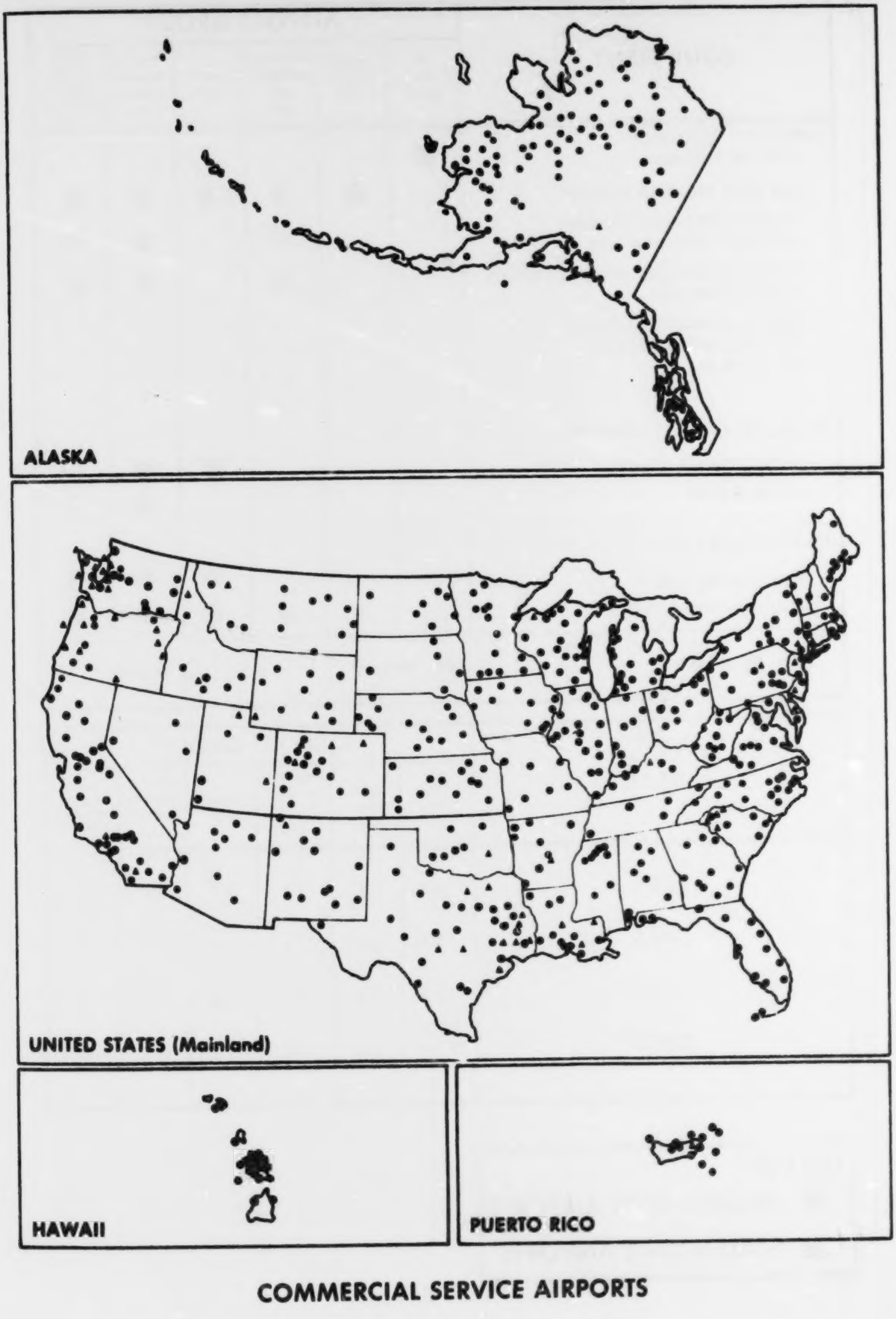
OTHER: ◍ CERTAIN; ⊖ PROBABLE; ⊝ POSSIBLE;

YEAR	AIRPORT GROUP					
	NO FAA EQUIP	VISUAL AIDS ONLY	PRECISION APPROACH AIDS ONLY	TOWER ONLY	TOWER & PRECISION APPROACH AIDS	TOWER, RADAR SERVICE & PRECISION APPROACH AIDS
1981	244	77	125	12	131	183
1985	219	81	164	15	151	183
1990	209	75	197	16	154	189
2000	189	70	248	5	168	206

LEGEND

● PRESENT CIVIL AIRPORTS

▲ FUTURE CIVIL AIRPORTS


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

COMMERCIAL SERVICE AIRPORTS

EQUIPMENT	AIRPORT GROUP					
	NO FAA EQUIP	VISUAL AIDS ONLY	PRECISION APPROACH AIDS ONLY	TOWER ONLY	TOWER & PRECISION APPROACH AIDS	TOWER, RADAR SERVICE & PRECISION APPROACH AIDS
APPROACH GUIDANCE						
NON-FED VASI/REIL	●					
FEDERALLY PROVIDED VASI/REIL		●	●	●	●	●
FEDERALLY PROVIDED MULTIPLE PRECISION APPROACH AIDS			●		●	●
FEDERALLY PROVIDED APPROACH LIGHTS (ALSF/MALS/SSALS)			●		●	●
FEDERALLY PROVIDED MULTIPLE PRECISION APPROACH AIDS (CAT I, II & III)						
SEPARATION AND SEQUENCING						
AIRPORT TRAFFIC CONTROL TOWER				●	●	●
RADAR SERVICE					◒	●
NAVIGATIONAL AIDS						
FED/NON-FED NDB				●	●	●
FED/NON-FED VOR/VORTAC			◒	●	◒	●

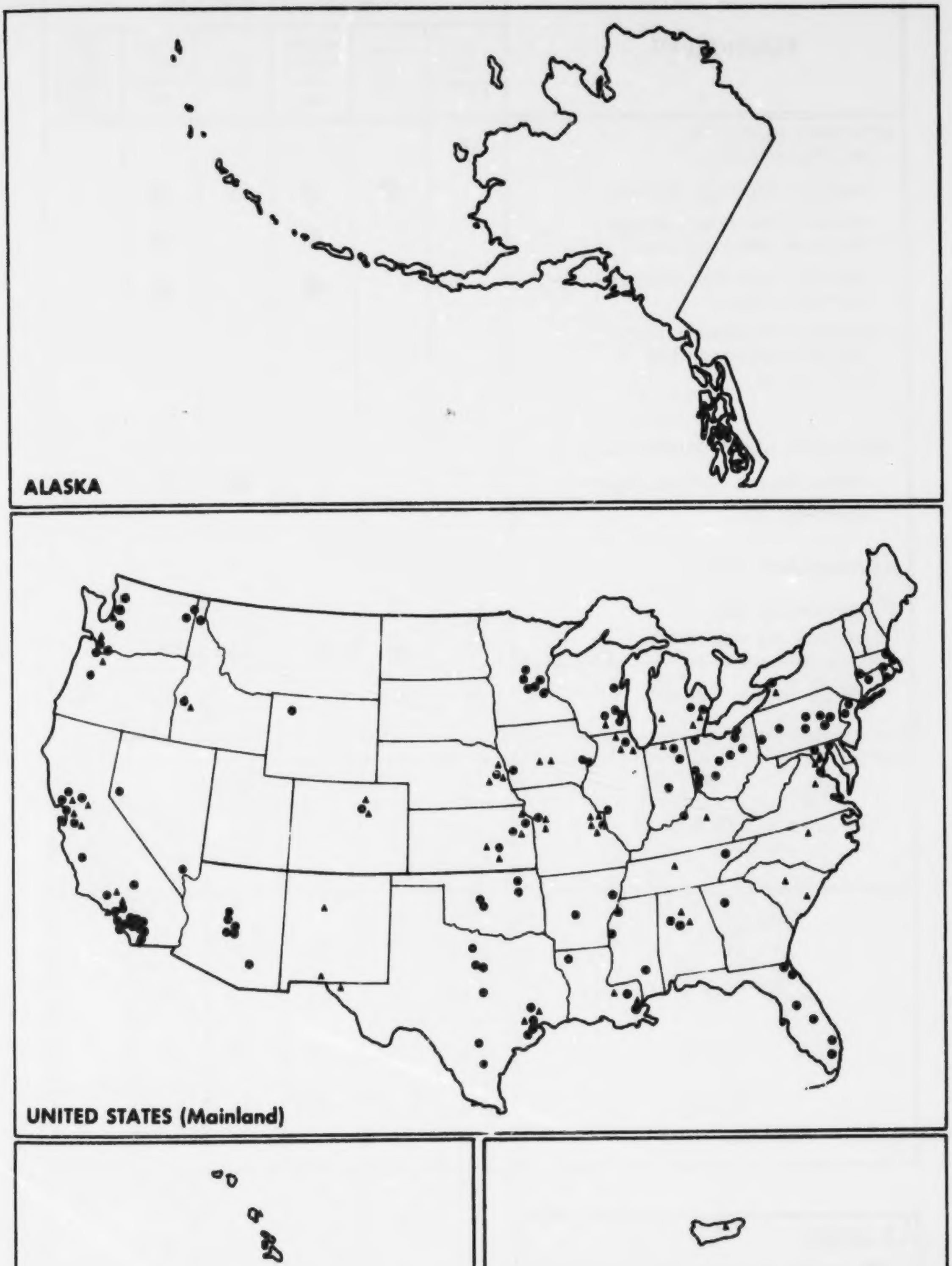
● CERTAIN ◓ PROBABLE ◒ POSSIBLE

YEAR	AIRPORT GROUP					
	NO FAA EQUIP	VISUAL AIDS ONLY	PRECISION APPROACH AIDS ONLY	TOWER ONLY	TOWER & PRECISION APPROACH AIDS	TOWER, RADAR SERVICE & PRECISION APPROACH AIDS
1981	70	7	11	31	41	3
1985	95	36	11	17	55	3
1990	103	30	13	14	60	3
2000	114	28	30	13	62	3

LEGEND

● PRESENT CIVIL AIRPORTS

▲ FUTURE CIVIL AIRPORTS


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

RELIEVER AIRPORTS

EQUIPMENT	AIRPORT GROUP					
	NO FAA EQUIP	VISUAL AIDS ONLY	PRECISION APPROACH AIDS ONLY	TOWER ONLY	TOWER & PRECISION APPROACH AIDS	TOWER, RADAR SERVICE & PRECISION APPROACH AIDS
APPROACH GUIDANCE						
NON-FED VASI/REIL	◓					
FEDERALLY PROVIDED VASI/REIL		●	◒	◒	●	
FEDERALLY PROVIDED MULTIPLE PRECISION APPROACH AIDS			●		●	
FEDERALLY PROVIDED APPROACH LIGHTS (ALSF/MALS/SSALS)			●		●	
FEDERALLY PROVIDED MULTIPLE PRECISION APPROACH AIDS (CAT I, II & III)						
SEPARATION AND SEQUENCING						
AIRPORT TRAFFIC CONTROL TOWER				●	●	
RADAR SERVICE						
NAVIGATIONAL AIDS						
FED/NON-FED NDB	◒	◒				
FED/NON-FED VOR/VORTAC		◒	◒	◒	◒	

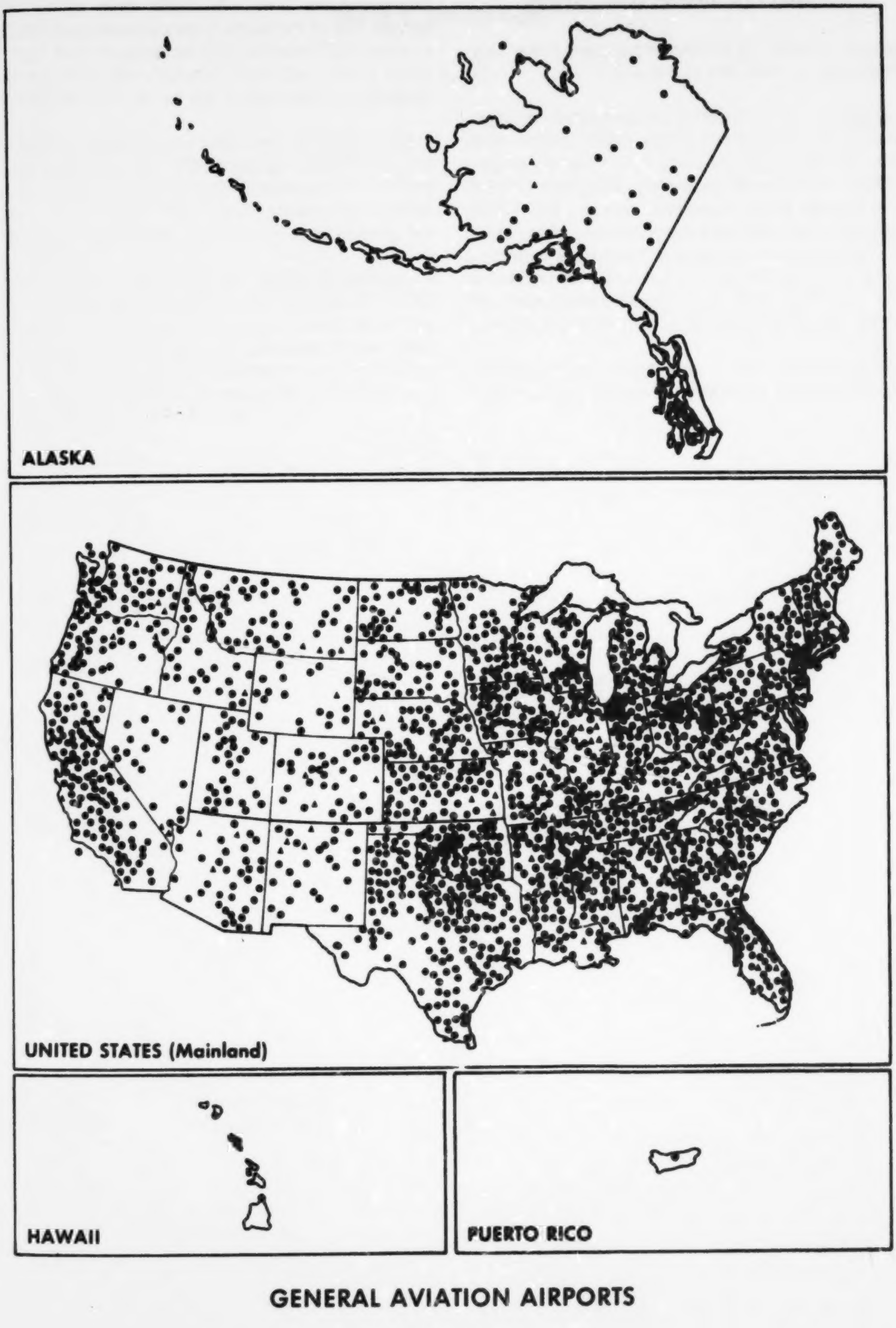
● CERTAIN ◓ PROBABLE ◒ POSSIBLE

YEAR	AIRPORT GROUP					
	NO FAA EQUIP	VISUAL AIDS ONLY	PRECISION APPROACH AIDS ONLY	TOWER ONLY	TOWER & PRECISION APPROACH AIDS	TOWER, RADAR SERVICE & PRECISION APPROACH AIDS
1981	2071	81	45	12	19	
1985	2440	82	46	6	27	
1990	2381	88	61	6	27	
2000	2584	156	92	5	29	

LEGEND

● PRESENT CIVIL AIRPORTS

▲ FUTURE CIVIL AIRPORTS


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

GENERAL AVIATION AIRPORTS

AIRBORNE EQUIPMENT UTILIZATION

Projected utilization of airborne equipment in the next two decades is illustrated in Table V.

- Navigation. Use of VORTAC, a co-located very high frequency omnidirectional range (VOR) station and tactical air navigation (TACAN) facility; area navigation, VOR with distance measuring equipment (DME); and, to a lesser extent, nondirectional beacons (NDB) are expected to continue through the end of the century. More advanced systems of mapping a 4-dimensional area navigation should become commonplace by the year 2000. The use of satellite navigation will increase, but still be too new to be in widespread use.

- Communication. Use of very high frequency (VHF) communications is anticipated to remain predominant throughout the period. By 2000, there will be widespread use of the Mode S transponder and data link system, VOR weather data broadcasts, and high frequency (HF) data link. Although not commonplace, satellite communications will be on the increase.

- Separation. The air traffic control radar beacon system (ATCRBS) transponders will be replaced by Mode S transponders. The traffic alert and collision avoidance system (TCAS), both TCAS II and TCAS I, will provide airborne collision avoidance capability.

- Landing Systems. The microwave landing system (MLS) will replace the instrument landing system (ILS) as the standard for precision approaches. Area navigation and Categories IIIA and B approaches are also expected to be in widespread use. The head-up display (HUD) will be receiving increasing use.

TABLE V. UTILIZATION

	1982	1985	1990	2000
NAVIGATION				
VOR/VORTAC	W	W	W	W
SATELLITE NAV			L	L
DME	W	W	W	W
INS	L	I	I	W
LORAN C	L	L	L	L
OMEGA/VLF	L	L	L	L
DOPPLER	L	D	D	D
NDB	W	W	W	W
RNAV	W	W	W	W
4D RNAV	L	W	W	W
MAPPING	L	I	I	W
COMMUNICATION & DATA LINK				
VHF COMM	W	W	W	W
UHF COMM	W	W	W	W
HF COMM	W	W	W	W
MODE S			L	W
ACARS	W	W	W	W
SATELLITE			L	I
VHF WX DATA BROADCAST (VOR)		L	W	W
HF DATA LINK			L	W
AIRCRAFT SEPARATION				
TCAS II		L	I	W
TCAS I			L	I
ATCRBS	W	W	D	D
MODE S			I	W
LANDING SYSTEMS				
MLS			W	W
ILS	W	W	W	D
ADF	W	W	W	W
VOR	W	W	W	W
RNAV	L	L	I	W
CAT IIIA	L	L	I	I
CAT IIIB		L	L	L
HUD		L	I	I

Legend:

L-Limited Use	W-Widespread
I-Increasing Use	D-Decreasing Use

CHAPTER III

ATC SYSTEMS

ATC SYSTEMS

The three major components of the air traffic control system are en route air traffic control, terminal air traffic control, and flight service stations.

Air route traffic control centers (ARTCC) control all en route aircraft in the United States which are operating under instrument flight rules and are not under the control of military or other facilities. The centers provide separation service, traffic advisories, and weather information to pilots while they are en route between airports. Terminal air traffic control facilities include airport traffic control towers (ATCT), terminal radar approach control (TRACON), and terminal radar approach control in the tower cab (TRACAB). Airport traffic control towers separate and sequence aircraft in the airspace immediately surrounding airports and on the airport's surface. Approach control facilities provide separation services to aircraft during the arrival and departure phases of flights in a larger amount of airspace surrounding airports. Flight service stations offer a wide range of services to the large general aviation public which would not otherwise be available. Services include flight plan filing and closing, preflight and in-flight weather briefings, en route communications with pilots flying under visual flight rules, and assistance to pilots in distress. This chapter describes in detail the specific improvements that must be made to en route, terminal, and flight service station facilities in order to safely and effectively meet the demands of air transportation between now and the year 2000 in a manner which will achieve cost savings. The artificial boundary between en route and terminal air traffic control will become increasingly blurred as the NAS Plan is implemented.

These improvements principally consist of:

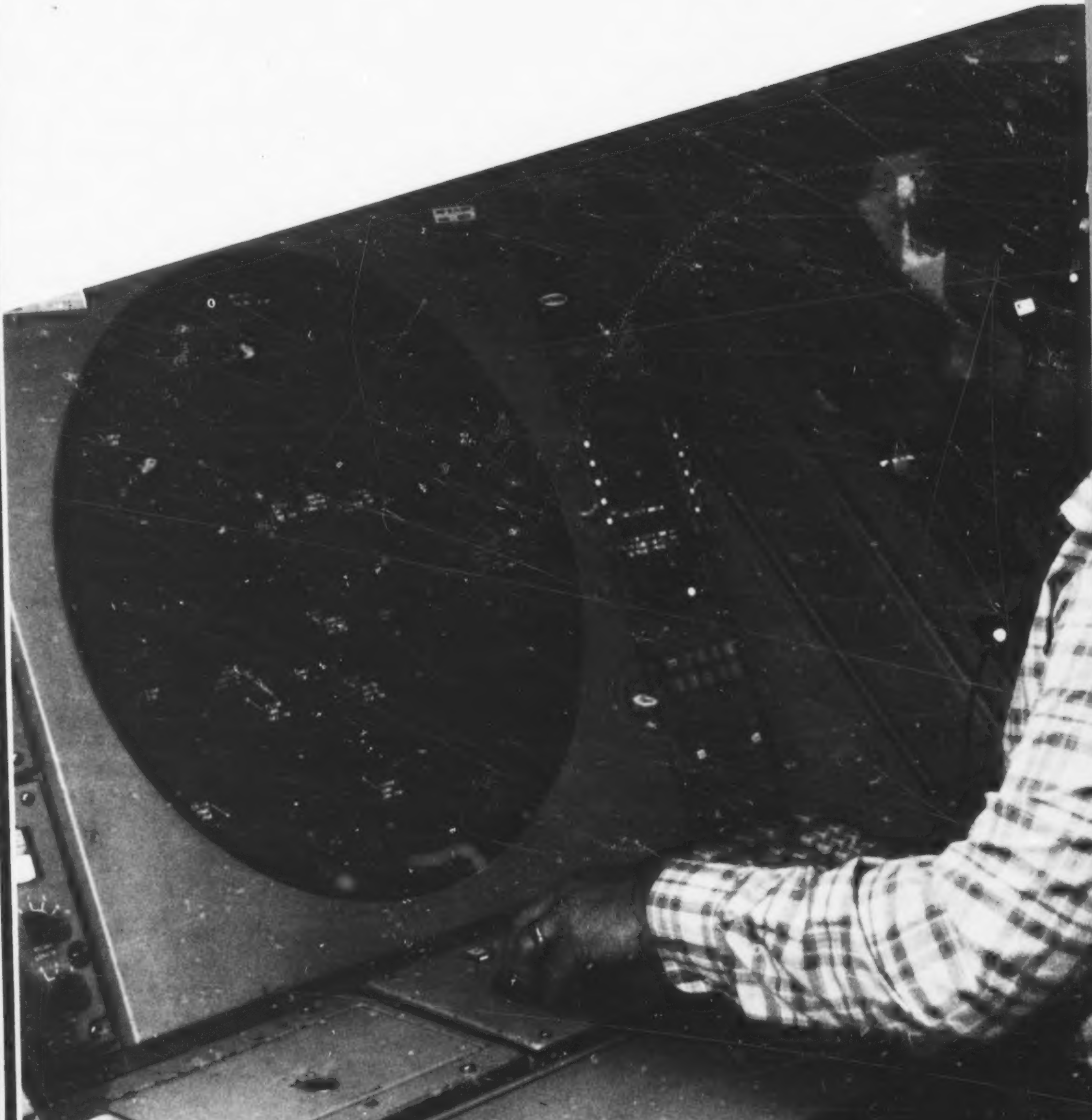
- Those that will upgrade current systems by adding or expanding safety-related functions or increasing capacity to accommodate demand while newer systems are being developed.

- Those that will apply high levels of automation to air traffic control and flight services. The most notable aspects of the systems approach are expanded, common, and readily available data bases and higher levels of service that result from automating operator tasks.

- Those that consolidate facilities. Consolidations will not only allow for the cost-effective introduction of new technology, but will also remove constraints to the orderly flow of traffic and create a more efficient work force. Consolidation is expected to be a major factor in the anticipated increase in productivity.

The air traffic control system evolved by this plan will improve safety and efficiency, be responsive to user needs, and satisfy increasing demands at minimum cost.

EN ROUTE



EN ROUTE SYSTEMS

Commercial airlines and other aircraft flying under instrument flight rules are monitored by air route traffic control centers. These centers control an aircraft's route of flight and altitude while it is en route between airports. Aircraft flying under visual flight rules are also monitored by these centers.

A typical center is responsible for more than 100,000 square miles of airspace and hundreds of miles of airways in the sky, which are like electronic highways to pilots. A current center's geographic area is usually divided into 30 or more sectors with a team of controllers responsible for each sector.

There are 20 air route traffic control centers in the continental United States. There are four offshore centers located at Anchorage, Honolulu, San Juan, and Guam. The San Juan and Guam Centers are combined center radar approach controls (CERAP).

Another integral part of the en route system is the central flow control facility. The central flow control computer complex is currently being upgraded and moved from Jacksonville, Florida, to the FAA Technical Center. The centrol flow control operational facility is the ATC Command Center in Washington, D.C. Central flow control serves as a focal point for evaluating and approving traffic flow redistribution and nationwide management of air traffic flow. It also provides authority for initiating systemwide flow control. Central flow control, associated with the Airport Reservation Function (ARF), relieves congestion at the busiest airports. When associated with the Central Altitude Reservation Function (CARF), it supports military operations and provides coordination of other activities requiring airspace protection. In times of emergency or calamity affecting an air traffic control facility, it also serves as the contingency command post (CCP) for coordinating and supporting major realignments of control responsibilities.

Most flight data, after being processed, are now displayed on paper strips torn from flight strip printers. This is a costly mechanical system requiring a great deal of manual effort and input by the air traffic controllers. Handoffs of aircraft from one controller to another, together with the required frequency changes, are also done manually.

The en route centers presently use 9020 computers developed in the 1960's. Three offshore control centers use en route automated radar tracking system (EARTS) computers to perform similar, but more limited, radar and flight data processing. Despite their capabilities, the current 9020 computer systems are not expected to be adequate for handling the projected growth in aviation traffic beyond the late 1980's.

Major enhancements to the operational software are not possible because of capacity limits. Higher levels of automation are being developed to further reduce operational costs, improve safety, and provide fuel savings for aircraft users.

In addition to its high hardware and software operating and maintenance costs, the present en route sytem is labor-intensive. Moreover, equipment manufacturers cannot continue to support the system indefinitely, regardless of the costs.

These en route centers control all aircraft in the United States operating under instrument flight rules (IFR) which are not under the control of military or terminal facilities. They provide separation services, traffic advisories, and weather advisories. In addition, they assist aircraft in distress. The FAA en route system is, of course, an integral part of this country's national defense system.

The air traffic control system determines correct aircraft separation based on radar data input. It also provides visual flight rules (VFR) traffic advisories and fixed route clearances based upon separation.

THE NEW APPROACH

FAA's current en route development programs are aimed at replacing existing air traffic control computer systems with new systems based on evolving technology. Admittedly large and costly, this program will provide and accommodate future enhancements which best meet the FAA's objectives and, at the same time, greatly benefit the users of the National Airspace System (NAS).

The new computer system will be designed for approximately 100 percent functional availability and reliability of services. Moreover, the new computers, software programs, and displays now under development will be capable of providing both en route and terminal services. This will enable the agency to consolidate and reduce the number of facilities needed. Airport traffic control towers, however, will still provide airport services. Significant savings in manpower, rents, utilities, and energy costs will be realized. Use of the same system for en route and terminal functions will also eliminate or considerably diminish the present, somewhat arbitrary, demarcation of services and, thereby, reduce operational overhead. Consolidation into area control facilities (ACF) is planned during the 1990's.

Thus, the new air traffic control computers will provide more reliable, safer services to the user, accommodate safety enhancements as they are developed, and enable the agency to reduce manpower, training, and logistics costs. Introduction of the automated en route air traffic control (AERA) functions, for example, into the new computer system will further enhance safety, controller productivity, and fuel savings for the users.

FAA plans call for replacement of the 9020 central computer complex in the mid-1980's with a host computer. (A host computer is a replacement computer which uses existing software from another computer system.) This host computer will be capable of running the present 9020 software package with minimal modifications. This will provide immediate relief from current capacity restrictions and provide for projected air traffic growth until the advanced automation system is in place.

In FY-83, the agency began action to procure new advanced automation systems (AAS) including sector suites with distributed processing minicomputers. This contract provides for development of replacement software programs partitioned to run in the host computers and sector suites. Operations requiring centralized processing will be accomplished in the host with all remaining functions performed within the individual sector suites. The designed failsoft and emergency modes of AAS operation and sector suite processing capability will ensure that surveillance, flight, and weather data are provided with 100 percent functional reliability. The acquisition approach minimizes the adverse impact of a major technical and operational transition. Additional safety and productivity functions will be included in the new software.

A typical sector suite will consist of displays which present a plan view of the current situation, such as: (1) search, beacon, and real-time weather; (2) electronic display of flight data (eliminating the need for the manual flight strip processing); and (3) the display of planning information and advanced functions such as AERA.

The capability of the system to support both en route and terminal functions allows for consolidation into area control facilities. Standardization, flexibility, and expandability of the system's design will allow universal application, reduction of total operations costs, and facilitate accommodations of future requirements and enhancements.

The voice switching and control system will provide automatic switching of communications. This capability will allow resectoring to meet demands. Leased-line and equipment costs will be reduced and permit eventual integration of voice and data communications. This will further reduce transmission costs.

The agency's replacement of the central flow control computer complex at Jacksonville with the Traffic Management Computer Center at the FAA Technical Center will improve flow management and allow expansion to cover more of the National Airspace System. The long-range goal will be to couple this traffic management capability with area control facilities for total national flow management.

In summary, FAA's present en route plans are designed to replace current air traffic control systems to meet future needs for greater capacity and reliability. With higher levels of automation, present en route plans will improve both safety and productivity. The new system will be capable of providing both en route and terminal services, thereby, enabling the agency to consolidate and reduce the total number of facilities needed to do the job.

HOW THE SYSTEM WILL EVOLVE

NEAR TERM (TO 1985)

During the near term, the FAA will develop a replacement for its 9020 computers with a new host computer capable of running slightly modified 9020 software programs. The new host computer is slated for complete development in l985. It will provide the additional capacity needed to handle the growth in air traffic expected beyond the mid-1980's.

During this same period, agency plans call for more automated interfaces between en route and terminal facilities to provide better coordination of operations. Near-term agency plans also call for the development of a central weather processing capability which will use weather radar information and weather data obtained from automated flight service stations. Replacement of mechanical, labor-intensive flight strip printers (FSP), and flight data entry and printout (FDEP) equipment will be underway. This will provide more reliable and faster electronic equipment which will improve productivity and computer capacity. Near-term software improvements will be aimed at improving controller productivity, aviation safety, and system reliability.

The agency plans to develop and evaluate new en route metering capabilities When implemented

(1987), this will cut back on delays and produce optimized fuel-descent profiles.

Development will continue to expand conflict alert to include detection of VFR aircraft equipped with Mode C transponders when they become a potential hazard to controlled aircraft. Similarly, development will continue for conflict resolution logic to assist controllers in preventing violations of separation standards.

The software for the en route automated radar tracking systems (EARTS) will be improved over the near term to provide conflict alert and minimum safe altitude warning systems. Among the first improvements to oceanic control systems will be automated situation displays which will assist in decisions on the most fuel-efficient routing.

The capability of the backup direct access radar channel (DARC) will be expanded to provide full data information tags and individual display switching. This will eliminate the need to use shrimp boats, adjust displays to a horizontal position, and switch six displays at a time to the backup channel as is now the case.

Successful completion of these near-term programs will enable the air traffic control system to handle the growth in traffic forecast for this period.

During this period, the 9020 central flow control computer complex will be replaced with an IBM 4341 computer with improved software. The traffic management computer center, consolidating all traffic management processing, will be completed. Traffic management within the centers will be automated, and the operational work stations at the ATC Command Center will be upgraded. The manual Central Altitude Reservation Function (CARF) and Airport Reservation Function (ARF) will also be automated at that time. In the near term, standard remote communications control equipment will be developed. The replacement of existing tone control channels will begin in 1987.

INTERMEDIATE TERM (TO 1990)

During this period, the replacement of control room display channel processors and displays by sector suites will have begun. The initial sector suite installation will coincide with the implementation of additional computer software to take advantage of initial sector suite capabilities. This step will prepare the way for integration of terminal and en route functions within area control facilities and for higher levels of automation when the full AAS is implemented in the 1990's.

Mode S will provide the basis for major system enhancements past 1990. Mode S will furnish improved surveillance, especially in high-density terminal areas. In addition, data link will provide rapid dissemination of weather information to equipped aircraft.

Enhanced safety levels will result through the use of IFR/VFR conflict alert and conflict resolution advisories. A foundation for greater government and user efficiency will be provided. The capabilities of the advanced automation system and Mode S will allow the expanded use of area navigation, rapid dissemination of control information, improved flight planning, and oceanic probes.

A complete voice switching and control system, which complements the capabilities of the new sector suite, will be developed and implementation will have begun. This will allow dynamic reconfiguration of sector communication, further reducing leased services cost.

The development of a significantly upgraded flow management function will be substantially completed. Software developed will enhance the ability to project and estimate NAS congestion and delay levels, provide this information to users, and evaluate alternate flow management strategies based on: arrival/departure messages, capacity, estimates from major terminals, data input from the flight service data processing system (FSDPS) on VFR flight plans, and input from the aviation weather processor (AWP) for national weather information.

Building, rehabilitation, and modernization will provide for heating and air conditioning replacements, upgraded electrical systems, compliance with Occupational Safety and Health Administration (OSHA) regulations, energy conservation, and improvements to security and roads.

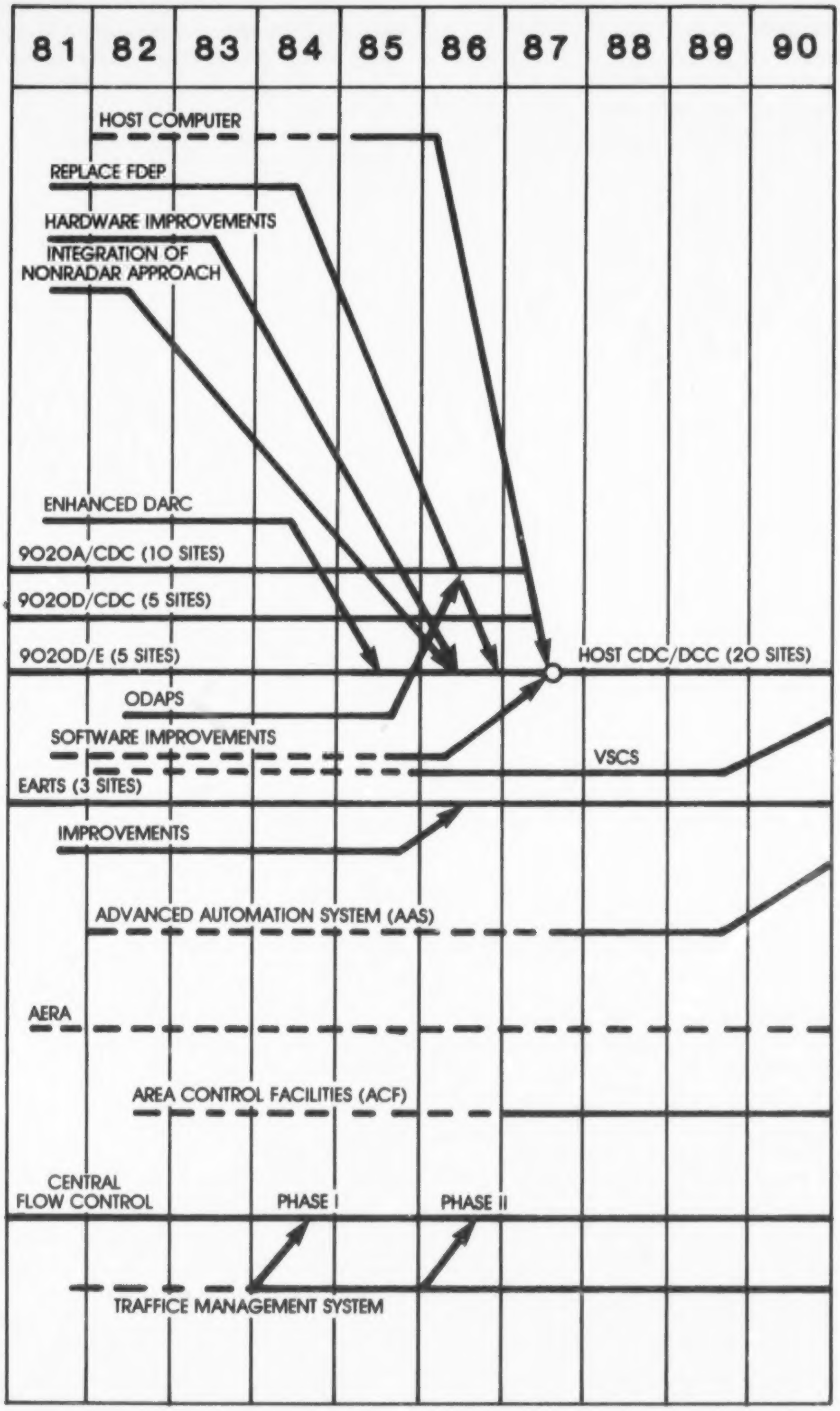
LONG TERM (TO 2000)

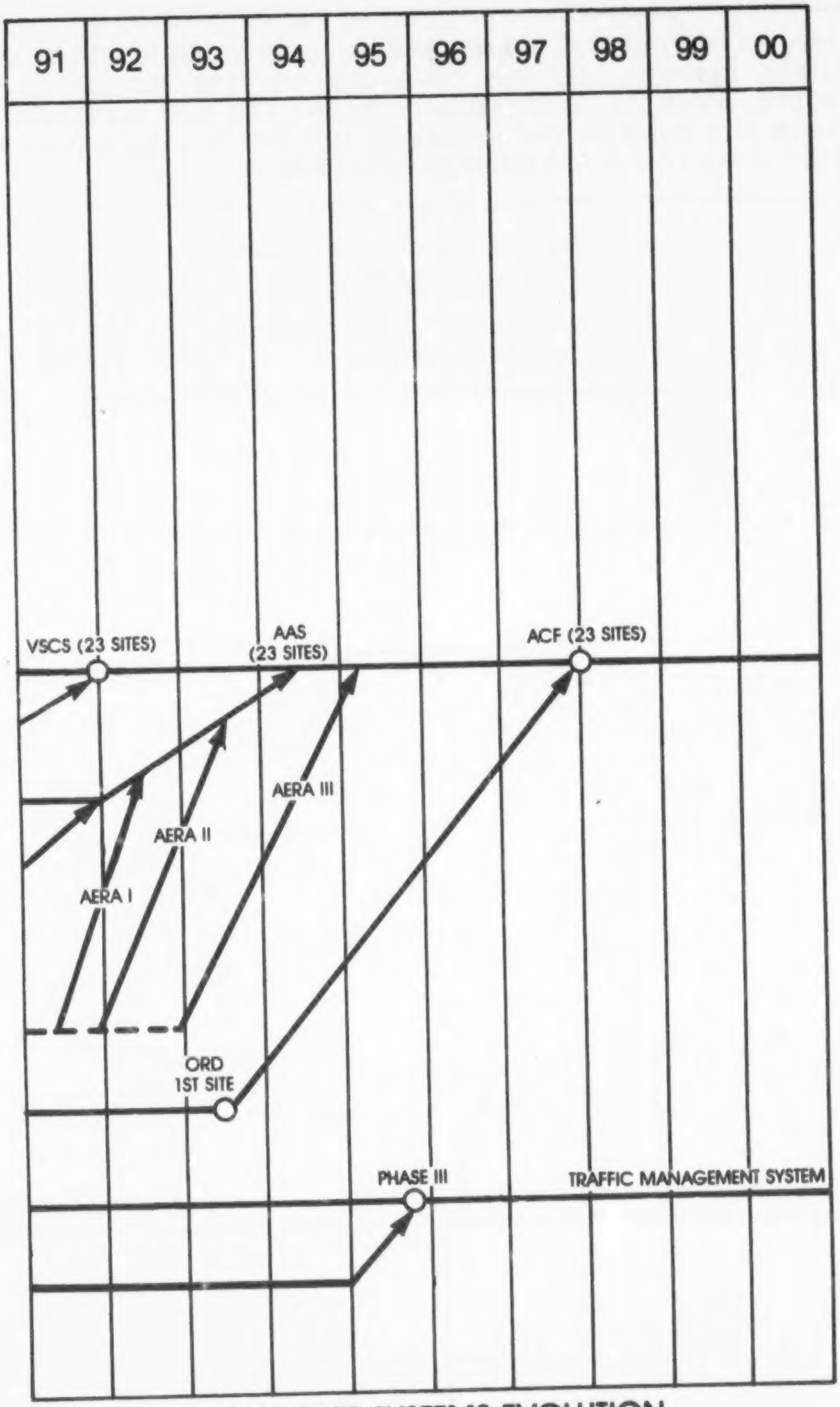
Activities early in this time period will implement consolidated en route and terminal functions in ACFs. The capacity and informational framework for higher levels of automation will exist and tools for operator use of the system at higher levels of automation will be installed.

During this period, the AERA functions will be implemented incrementally in the following sequences: (1) fuel-efficient routing, flow planning, and traffic management, (2) advisory action extension, and (3) automatic clearance delivery via data link. The upgraded flow management function will be implemented.

These activities will result in higher levels of safety and efficiency through the use of automated conflict probe and resolution, systemwide direct routing, and the capability to normally operate a sector with one person.

Services provided by this country's future air traffic control system will be significantly better and more cost-effective; system reliability will be much higher. The increased use of automation will significantly improve both safety and efficiency. Introduction of more advanced automation functions into the system will result in even greater fuel savings. The following diagram and maps describe the evolution of the system.

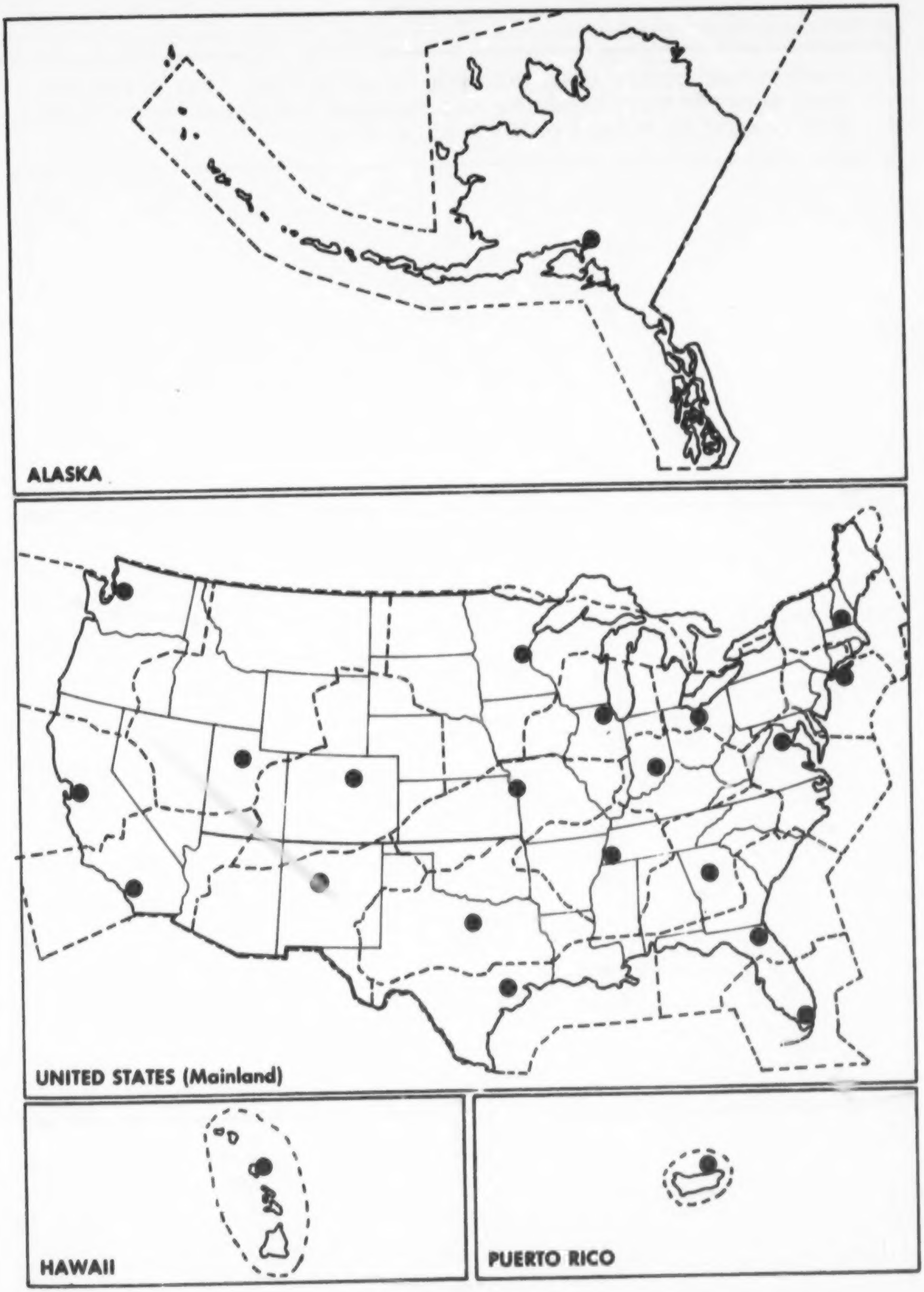

81
82
83
84
85
86
87
88
89
90
HOST COMPUTER
REPLACE FDEP
HARDWARE IMPROVEMENTS
INTEGRATION OF NONRADAR APPROACH
ENHANCED DARC
9020A/CDC (10 SITES)
9020D/CDC (5 SITES)
9020D/E (5 SITES)
HOST CDC/DCC (20 SITES)
ODAPS
SOFTWARE IMPROVEMENTS
VSCS
EARTS (3 SITES)
IMPROVEMENTS
ADVANCED AUTOMATION SYSTEM (AAS)
AERA
AREA CONTROL FACILITIES (ACF)
CENTRAL FLOW CONTROL
PHASE I
PHASE II
TRAFFICE MANAGEMENT SYSTEM


91
92
93
94
95
96
97
98
99
00
VSCS (23 SITES)
AAS
(23 SITES)
ACF (23 SITES)
AERA I
AERA II
AERA III
ORD
1ST SITE
PHASE III
TRAFFIC MANAGEMENT SYSTEM

EN ROUTE SYSTEMS EVOLUTION

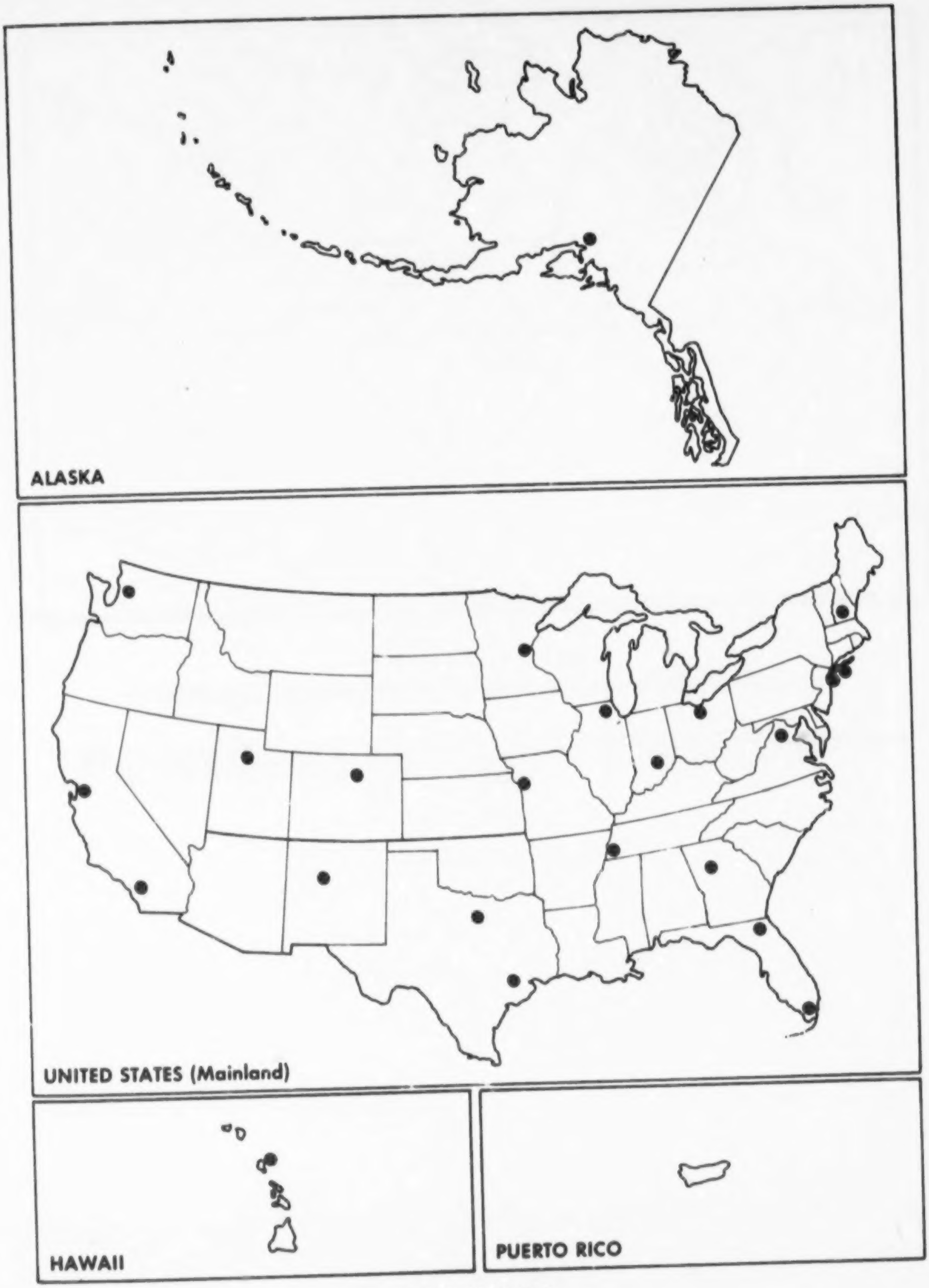
IN 1981, 20 CONTINENTAL UNITED STATES (CONUS) AIR ROUTE TRAFFIC CONTROL CENTERS AND FIVE OFFSHORE CENTERS SUPPORTED U.S. DOMESTIC AIRSPACE. TWO MANUAL CERAPs ARE NOT DEPICTED; I.E., PANAMA AND GUAM. IN THE SPRING OF 1983 THE PANAMA CERAP WAS TURNED OVER TO THE PANAMANIAN GOVERNMENT.

------	FLIGHT ADVISORY AREAS
●	AIR ROUTE TRAFFIC CONTROL CENTERS (ARTCCs)

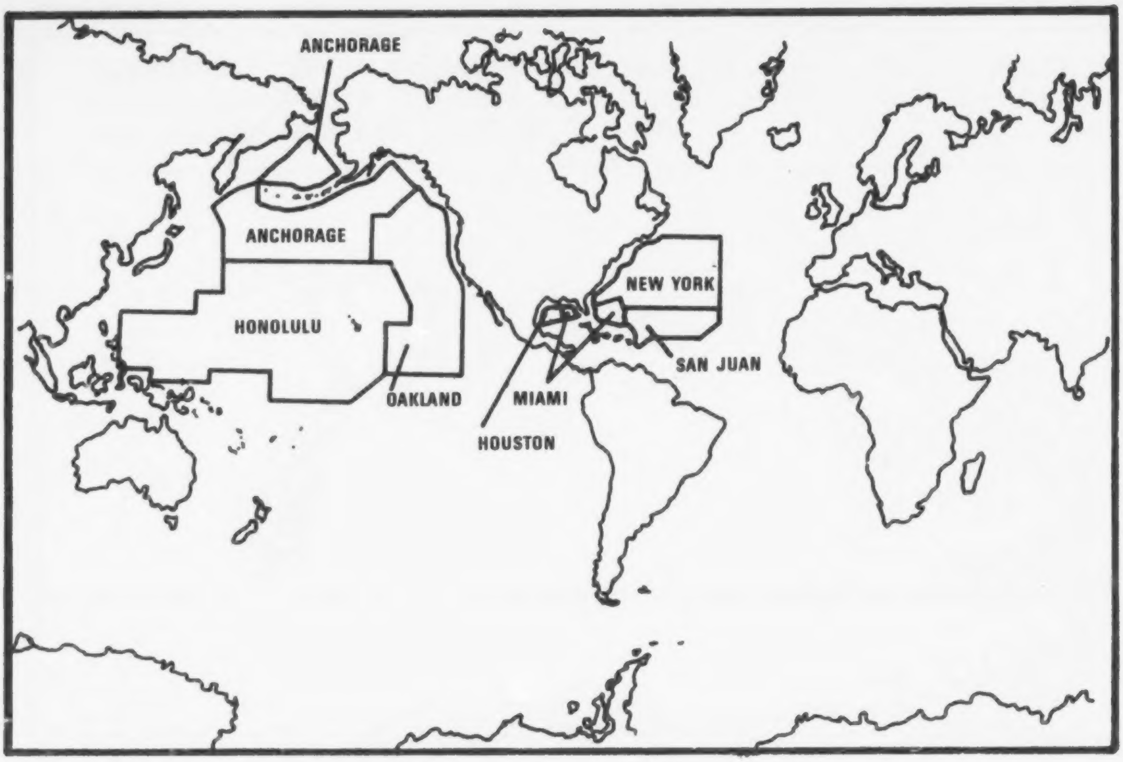

ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1981-1990 SYSTEM
ARTCC AND FLIGHT ADVISORY AREA

TWENTY-ONE CONUS AREA CONTROL FACILITIES AND TWO OFFSHORE ACFs SUPPORT BOTH EN ROUTE AND TERMINAL FUNCTIONS. LOCATIONS MAY CHANGE AS PLANS CONTINUE TO DEVELOP.

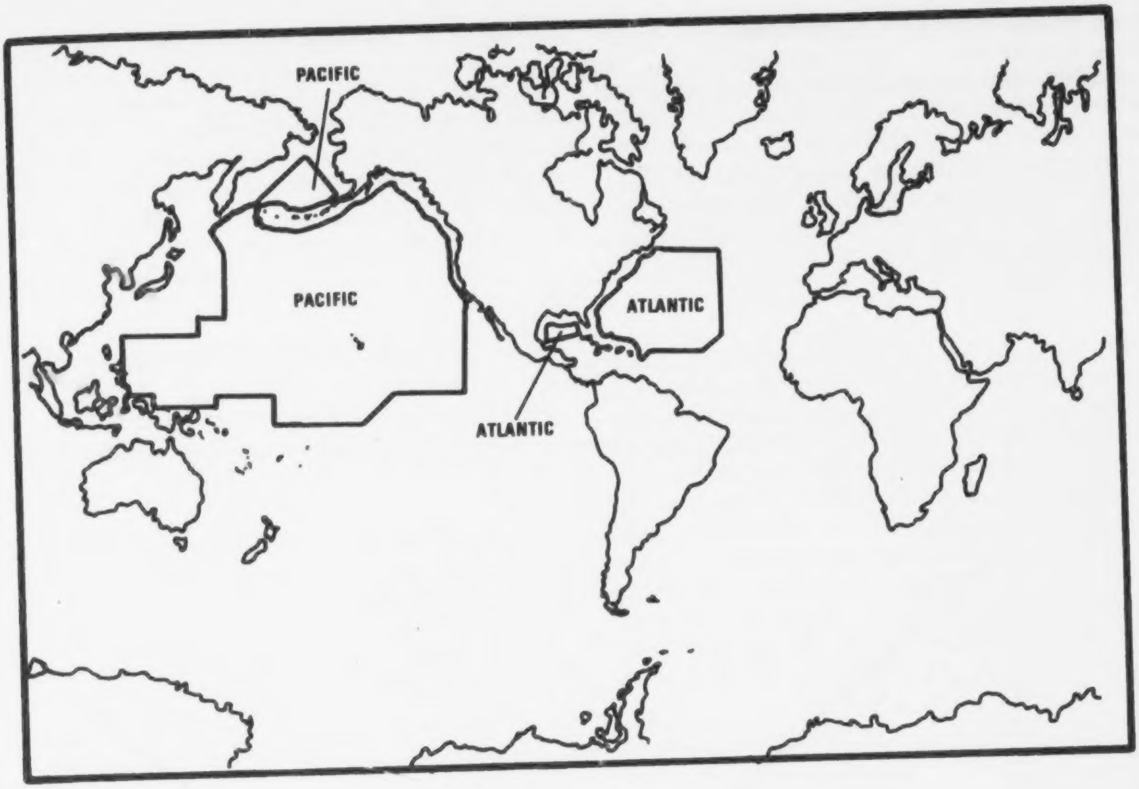

ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

2000 SYSTEM
AREA CONTROL FACILITIES


ANCHORAGE
ANCHORAGE
NEW YORK
HONOLULU
SAN JUAN
OAKLAND
MIAMI
HOUSTON

1981-1990 SYSTEM
INTERNATIONAL FLIGHT INFORMATION REGIONS (FIR)

SEVEN CENTERS SUPPORTING U.S. CONTROLLED INTERNATIONAL FLIGHT INFORMATION REGIONS


PACIFIC
PACIFIC
ATLANTIC
ATLANTIC

2000 SYSTEM
INTERNATIONAL FLIGHT INFORMATION REGIONS (FIR)

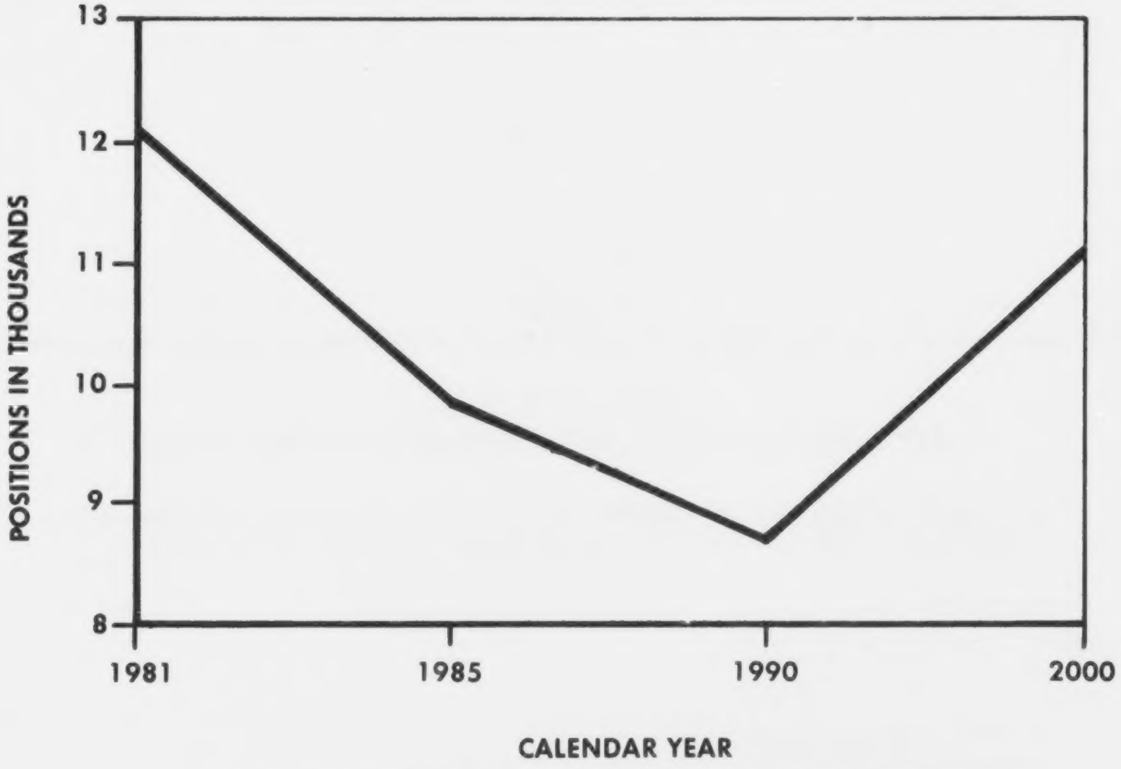
TWO CENTERS SUPPORTING U.S. CONTROLLED INTERNATIONAL FLIGHT INFORMATION REGIONS (LOCATIONS MAY CHANGE AS PLANS CONTINUE DEVELOPMENT)

RETURN ON THE INVESTMENT

As a result of these planned actions, an upgraded air traffic control system will have been implemented. This will serve as the basis for significant improvements in air safety and will provide the reliability and flexibility necessary for further automation. These system improvements will allow for reductions in maintenance staffing and a substantial decrease in the number of air traffic controllers.

FIELD EMPLOYMENT

During the next 20 years, the en route system will undergo changes in hardware, software, and plant improvement. These changes will reduce both Air Traffic and Airway Facilities employment as shown in the chart below:



AIR TRAFFIC/AIRWAY FACILITIES EMPLOYMENT
(EN ROUTE SYSTEMS)

The net effect of these changes will be a decrease in the current Airway Facilities personnel requirements at FAA field facilities by 35 percent. Air Traffic personnel requirements, as shown in the accompanying tables, decrease through 1990. The apparent increase after 1990 is, in reality, due to consolidation of terminal operations into en route facilities. The combined total of en route and terminal air traffic controller staffing will decrease by 36 percent.

SUMMARY OF FACILITY CHANGES

1981—Airway Facilities (AF) and Air Traffic (AT) employment for 207 facilities required a total of 12,124 people.

1985—Air Traffic employment will decrease to 8,525 because of strike recovery efforts and reductions made possible by enhancing the direct access radar channel (DARC) and resectoring en route airspace. Airway Facilities employment will decrease to 1,408, principally because of the complete removal of broadband radar equipment and the elimination of two offshore CERAPs. Thus, a total AT and AF work force of 9,933 will be required to operate and support 357 facilities.

1990—Air Traffic employment will decrease due to the introduction of the advanced capabilities of sector suite. Airway Facilities employment will decrease due to the replacement of the central computer complex and other equipment within the ARTCC.

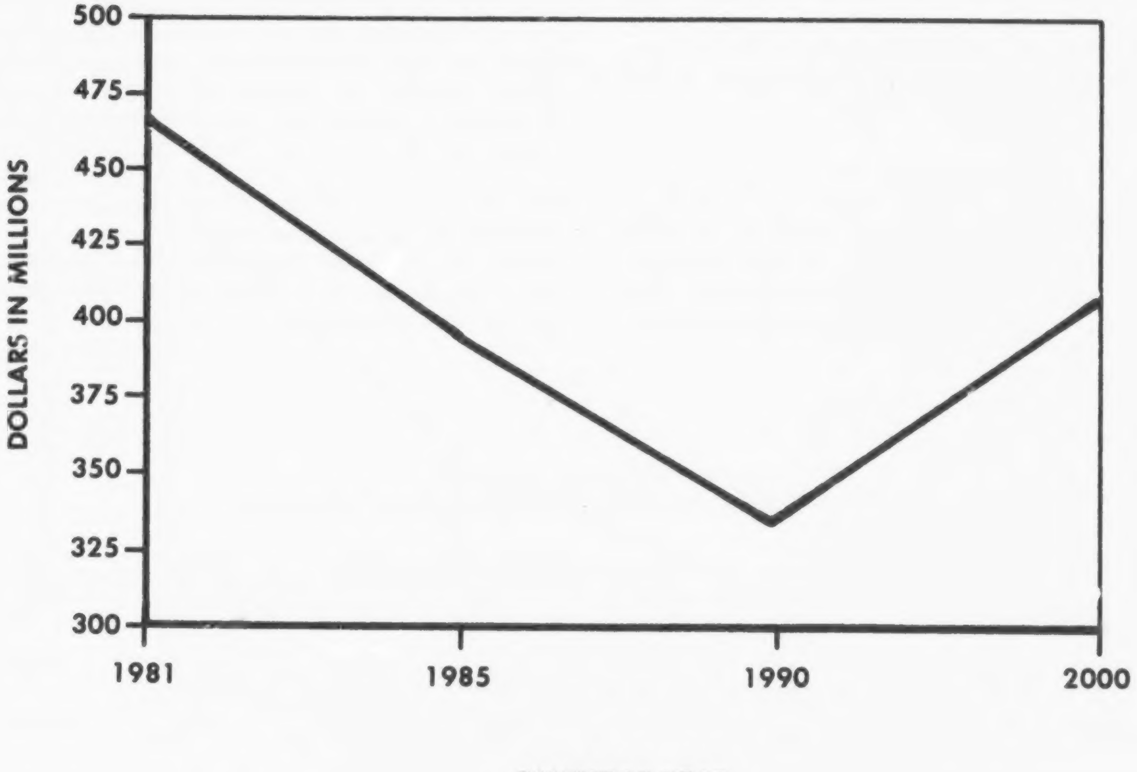
2000—Air Traffic employment will increase to 9,800 due to the consolidation of terminal and en route operations into area control facilities. This apparent increase, however, is negated by the decrease in employees previously required for terminal radar approach controls (TRACON). The total AT employment for en route and terminal facilities will actually decrease from 16,700 to 14,200 due to consolidation and the capabilities of advanced automation. Airway Facilities employment increases slightly due to ACF establishment. This increase is more than offset by the elimination of TRACON workload.

EN ROUTE/ACF SYSTEMS
AIR TRAFFIC/AIRWAY FACILITIES EMPLOYMENT CHANGES

	1981	1985	1990	2000
No. of Facilities	207	357	450	93
Operations (millions)	27.3	32.1	37.4	105.8
Air Traffic Personnel	10,300	8,525	7,500	9,800
AT Productivity Quotient	2,650	3,765	4,987	10,795
Airway Facilities Personnel	1,824	1,408	1,096	1,181
AF Productivity Quotient	14,967	22,798	34,124	89,585
Total AT & AF Staffing	12,124	9,933	8,596	10,981

FIELD OPERATIONS COSTS

Operating costs are a summation of estimated annual expenditures for field personnel, leased communications, rents and utilities, and other miscellaneous items. The costs for each of the years in this play are a direct consequence of facility changes and their impact in these areas. Costs are in constant FY-81 dollars.



OPERATIONS COSTS

Air Traffic personnel costs are based on the expected number of controllers and support personnel required at air route traffic control centers through 1990 and at area control facilities through the year 2000. The salary figure for 1981, multiplied by the number of expected positions, is used to determine the total Air Traffic personnel costs for each of the years in the plan.

Airway Facilities personnel costs are derived by multiplying the total number of employee-years associated with the maintenance of field equipment by the average salary of an electronics technician in 1981, $34,100. The cost figures shown are based on the current demography of the AF work force and the expectation that trainee technicians and administrative positions will remain small compared to the overall field work force. These costs are summarized at the end of this section.

Leased Communications. Leased communications costs include leased 300-type switching systems, modems, etc., in ARTCCs and operations-funded local telephone charges. Changes expected are:

1981-1985—Impact of the AT&T divestiture will begin to be seen in higher lease and maintenance costs in 1984. No real competition is expected due to impracticality of early replacement of the Bell 300 switching systems. Higher rates will increase costs 67 percent over 1981.

1985-1990—Costs will continue to increase until 1989 when the VSCS begins to replace the Bell 300 systems. Installation of FAA modems and multiplexing of data will further reduce costs during this period.

1990-2000—All leased switching systems and most, if not all, of the remaining leased communications devices will be replaced by FAA-owned subsystems and costs will be reduced to local telephone services and toll charges.

Rents and Utilities. A summation of estimated annual expenditures for all charges for renting equipment; land and buildings; electrical, gas, and water services; etc.

Increases in rent and utility costs will be partially offset as facilities are changed over to solid-state equipment and consolidated. Energy costs, however, are expected to rise, as shown in the following section, despite reduced consumption.

Other. A summation of all other services not otherwise classified, such as storage of household goods, automotive maintenance and repair, aircraft rental, repair of technical building facilities and grounds, etc.

The table below summarizes annual operations costs in the en route system.

EN ROUTE/ACF SYSTEMS OPERATIONS COSTS (000)

	1981	1985	1990	2000
Air Traffic Personnel	368,740	305,195	268,500	350,840
Airway Facilities Personnel	62,198	48,013	37,374	40,272
*Leased Communications	12,000	20,000	14,000	1,400
Rents & Utilities	12,866	9,405	8,370	9,307
Other	6,842	9,100	7,079	7,630
Totals	462,646	391,713	335,323	409,449

*Costs shown are best estimates at the time of publication. Actual costs may differ due to negotiated tariffs.

ENERGY COSTS

Changes to the energy consumption and costs in the table below are a result of:

1985—Consumption will be reduced by changeover of facilities from tube-type to solid-state devices and energy conservation.

1990—Changeover of facilities from tube-type to solid-state and energy conservation will continue. Also, plant equipment will be improved.

2000—Small increase due to ACF additional sector suites for approach/departure control functions.

EN ROUTE/ACF SYSTEMS ENERGY DATA

	1981	1985	1990	2000
Energy (kWh × 10^6)	220	176	158	175
Costs (Millions)	11.0	8.8	7.9	8.8

SPECIFIC PROJECTS

The plan calls for 15 separate projects related to upgrading the en route system, falling under two basic categories: automation and facilities consolidation.

PROJECTS	IMPLEMENTATION	
	FIRST	LAST
AUTOMATION		
1. En Route Automation Hardware Improvements and Enhancements	1983	1986
2. Flight Data Entry and Printout Devices	1984	1987
3. Direct Access Radar Channel (DARC) System	1984	1985
4. EARTS Enhancements	1985	1986
5. Oceanic Display and Planning System (ODAPS)	1985	1986
6. Traffic Management System	1983	1995
7. Modern ATC Host Computer	1986	1987
8. En Route Metering II (ERM II)	1986	1987
9. Conflict Resolution Advisory Function	1987	1987
10. Conflict Alert IFR/VFR Mode C Intruder	1986	1987
11. Voice Switching and Control System (VSCS)	1989	1992
12. Advanced Automation System	1989	1994
13. Automated En Route Air Traffic Control (AERA)	1991	1995
FACILITY CONSOLIDATION		
14. Integration of Nonradar Approach Control into Radar Facilities	1982	1986
15. Area Control Facilities (ACF)	1993	1998

PROJECT SUMMARY

PROJECT 1: En Route Automation Hardware Improvements and Enhancements

Purpose: This project incorporates the necessary repairs and improvements to allow the present computer systems to continue in operation to support air traffic control until replacement of the 9020 central computer complex. The 9020 system must continue to operate at the current level of reliability until the replacement system is installed. Current conditions indicate significant problems may be encountered with certain hardware components in the interim. This project will provide sound technical approaches for dealing with these problems as they arise.

Approach: Hardware changes have been developed which are required to maintain the present level of performance. The following changes have been identified as the most cost beneficial and are in various stages of being incorporated:

- Identification and replacement of deteriorating cables which are causes of intermittent equipment problems.
- Identification and replacement of marginal and/or intermittent printed circuit board modules responsible for numerous system faults.
- Replacement of aging labor-intensive, medium-speed printers with a newer, more reliable unit. (This task has been completed.)
- Replacement of aging disk read/write heads resulting in fewer read/write errors.

The current 9020 system must function until it is replaced by the host computer system beginning in 1986. If the 9020 system is not replaced by that time, additional changes will be required as well as increased funding.

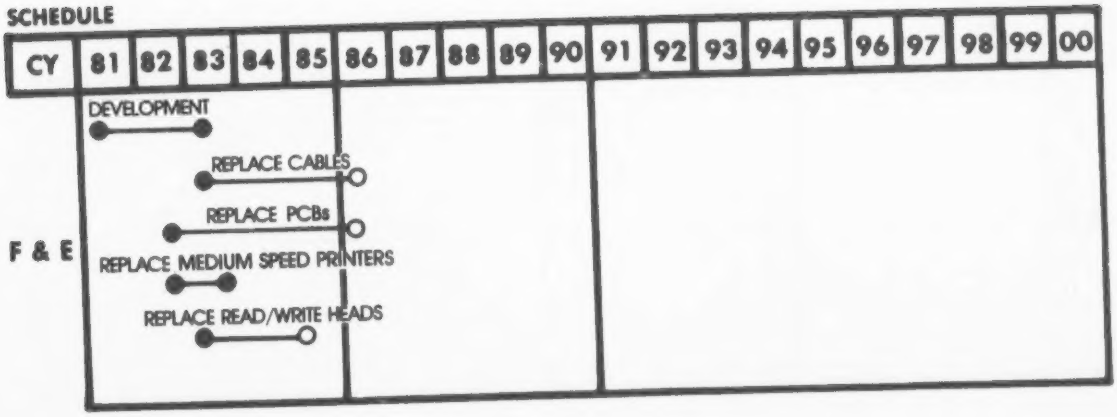
SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

Products:

- New cables manufactured at the Depot or locally as required.
- Replacement and repair of marginal and/or intermittent printed circuit board modules.
- New medium-speed printers.
- Replacement of disk read/write heads as required.

Related Projects/Activities: FDIO and Modern ATC Host Computer—further changes will have to be identified if either of these projects are delayed.



PROJECT 2: Flight Data Entry and Printout Devices

Purpose: The flight data input/output (FDIO) project will replace the existing flight data entry and printout (FDEP) and en route flight strip printer (FSP) systems and establish FDIOs at additional airport locations. Replacements will result in a reduction in manpower-intensive equipment and in a savings of up to $3 million a year. New establishments allow the automatic exchange of flight data with the air route traffic control centers over telephone lines. Automatic exchange is a vast improvement over manual exchange which is time-consuming, can cause delays to air traffic, and can create the potential for human error because the flight plan information is copied by hand. New establishments will result in a reduction in overall manpower (operators and technicians) costs up to $6 million a year.

Approach: A basic contract with multiyear delivery requirements has been awarded. The FDIO program consists of ARTCC systems, systems for the FAA Academy, the FAA Technical Center, 315 remote systems, spare parts, documentation, engineering support services, implementation plans, and test procedures. Possible requirements for additional equipment, 9020 interface data, training, and automated NAS documentation may necessitate future-year procurements. A rewrite of a portion of the 9020 software will be necessary to utilize the general purpose output/general purpose input (GPO/GPI) adapters in lieu of the FDEP adapters currently used. The software will be required to process both old and new systems simultaneously during transition.

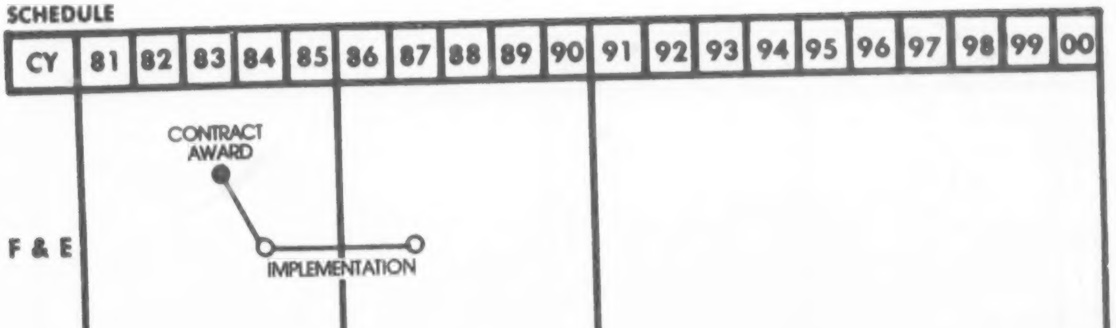
SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

Products: The program includes the replacement of 900 FSPs at the ARTCCs, FAA Academy, and FAA Technical Center funded in FY-81; the replacement of 205 FDEP systems and establishment of 8 FDIO systems funded in FY-81 and FY-82; and establishment of 100 FDIO systems funded in FY-83. Also included is the establishment of seven FDIO systems and 537 cathode-ray tube displays funded in FY-84. Military requirements for 111 FDIO systems are to be included. Options for 64 FDIOs are also included.

Related Projects/Activities: DOD interfaces and requirements are included in the FAA's contract. ODAPS and ATCT/TRACON relocate, modernize, and takeover. Software development.

SCHEDULE



PROJECT 3: Direct Access Radar Channel (DARC) System

Purpose: The current DARC system was in place in all 9020 ARTCCs in June 1981. The enhanced DARC (E-DARC) will upgrade this backup system to look and function in a similar manner to NAS. E-DARC will provide tracking, mosaicking, and real-time quality control and will allow each controller to select his mode of operation, either NAS or E-DARC, at his radar console. E-DARC will significantly increase air traffic productivity and minimize the possibility of sector(s) being totally nonradar. From the controllers' viewpoint, E-DARC will eliminate the use of shrimp boats and the need to move the plan view display (PVD) to the horizontal position.

Approach: This procurement provides hardware and software design, development, production, documentation, installation, and test for three systems to be installed by turnkey contract (FAA Technical Center, FAA Academy, and one ARTCC) and delivery of systems for the remaining ARTCCs to be installed by FAA personnel.

The E-DARC modifications include system analysis recorders (SAR) for post air traffic incident review, doubling memory and processing power by adding plug-compatible metal-oxide semiconductor (MOS) memory and microcomputer boards, tracking, mosaicking, and real-time quality control. Additionally, modified display generator input/output boards, cable harnesses for individual PVD switching capability, and fully automatic display processor and generator sparing will be provided. Software delivered and tested by the contractor at the FAA Technical Center and FAA Academy will be baselined and distributed to a selected ARTCC for key-site testing. Subsequent to key-site testing, software will be delivered to the remaining ARTCCs.

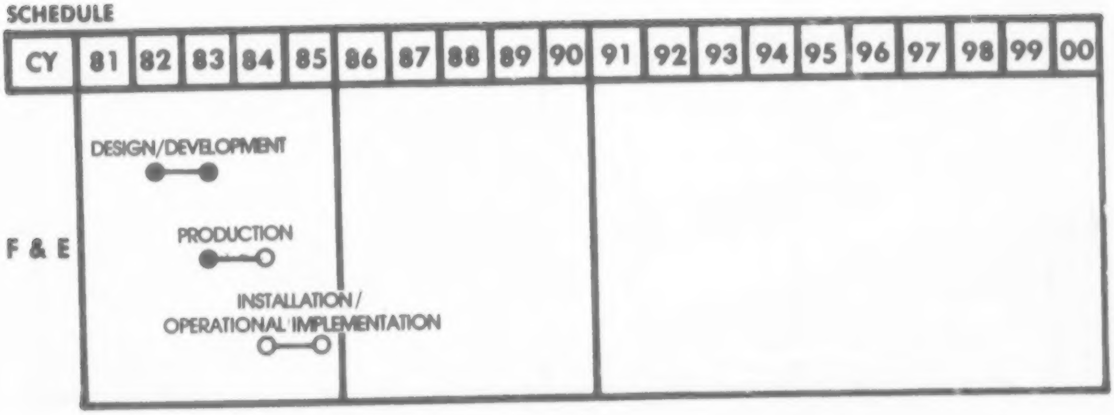
SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

Products: 22 enhanced DARC (E-DARC) systems—20 for ARTCC, 1 for FAA Technical Center, 1 for FAA Academy.

Related Projects/Activities: E-DARC is required for host and AAS transitions. The host initial software package must include NAS/DARC interface enhancements. E-DARC will provide surveillance backup in sector suite until AAS is operational. Improved weather display capability will require DARC software modification.

SCHEDULE



PROJECT 4: EARTS Enhancement

Purpose: This project will enhance air safety, increase ATC system capacity, and reduce fuel consumption by providing radar data mosaicking, conflict alert, and minimum safe altitude warning for EARTS.

Increased radar coverage allows more efficient use of airspace. Fewer controllers and less aircraft fuel will be required to maintain present capacity. For FAA to fully utilize the USAF's minimally attended radar (MAR) in Alaska, changes and additions to the EARTS hardware and software are necessary to interface and accept the MAR-generated digital target reports and status messages. FAA must also incorporate modifications to the affected MAR units to obtain beacon performance.

Conflict alert (CA) and minimum safe altitude warning (MSAW) capabilities will be provided to alert air traffic control personnel to potential hazardous in-flight conditions where less than standard separation exists between aircraft, aircraft and the ground, or aircraft and ground obstructions.

Approach: As the USAF's Alaskan Air Command updates and provides narrowband data from their long-range radars back to Anchorage, this data (beacon only) will be provided to the Anchorage ARTCC. EARTS will be expanded and upgraded to effectively utilize and display this data; i.e., consoles, reformatters, processors, and mosaic software will be added. For software maintainability, the EARTS mosaic software will also be delivered to Honolulu, San Juan, and Nellis Air Force Base. CA and MSAW software and hardware changes will then be added.

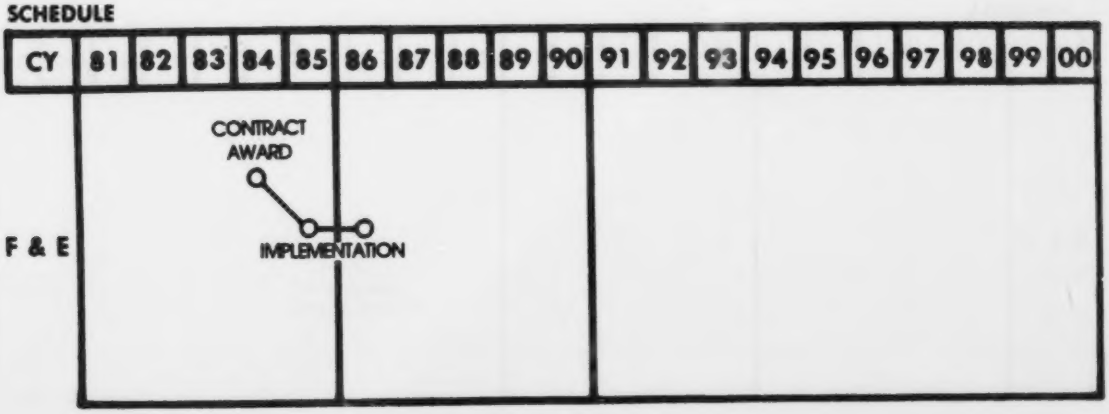
Products: Four upgraded operational EARTS.

Related Projects/Activities: Possible joint procurement of minimally attended radars for joint-use, long-range radar sites elsewhere. The advanced automation system will replace the EARTS systems at FAA locations. This project contains the consolidated activities described in the 1983 edition under the titles Alaska EARTS Enhancement and Provide Conflict Alert and Minimum Safe Altitude Warning for EARTS.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

SCHEDULE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CONTRACT AWARD
IMPLEMENTATION

PROJECT 5: Oceanic Display and Planning System (ODAPS)

Purpose: ODAPS provides automation assistance for oceanic ATC. Included is an automated conflict probe which will allow controllers to assign fuel-efficient routes and altitudes without revising separation standards. These fuel savings will be realized without adverse impact on NAS Stage A.

The current use of random tracks, inefficient flight data posting, and unstructured traffic flow in the ocean flight information regions (FIR) limits aircraft use of fuel-efficient altitudes. Oceanic controllers confronted with an increasing number of random and unorganized flight tracks are not able to visualize the spatial relationships of aircraft from data presented on flight progress strips or plotting boards. The maintenance of the strip and board displays and the methods for transfer of flight data are labor intensive and antiquated. The major advancement made in the oceanic air traffic control system during the past 30 years has been the automated printing of flight progress strips. The new system will compare the protected airspace of aircraft and inform the controller whether the cruising altitude or route is safe and when transition can be made. This function will allow controllers to honor more requests for flight profiles requested by users and create a safer and more efficient environment in oceanic airspace.

Approach: Procure oceanic automation systems comprised of unique displays, processors, and interfaces with other ATC systems. The system will operate until the advanced automation system is implemented.

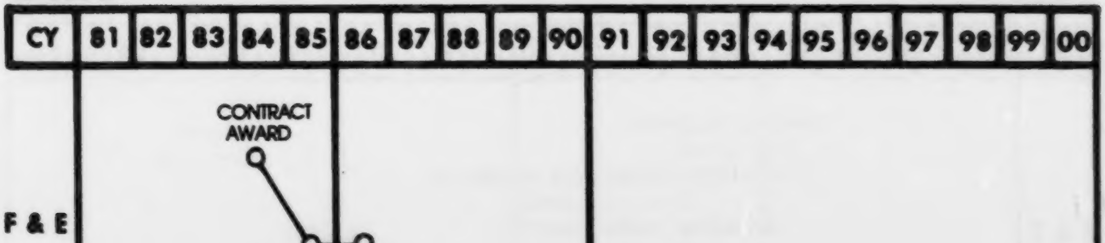
Products: 3 ODAPSs — 2 operational sites and 1 at the Technical Center.

Related Projects/Activities: Advanced Automation System (AAS)—requirements for oceanic automation are contained in the AAS project. FDIO will replace oceanic strip printers.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

SCHEDULE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CONTRACT AWARD
OPERATIONAL IMPLEMENTATION

PROJECT 6: Traffic Management System

Purpose: This project will upgrade the present flow control system into a fully integrated traffic management system which will include the Central Flow Control Function (CFCF), Central Altitude Reservation Function (CARF), Airport Reservation Function (ARF), emergency operations facility, central flow weather service unit (CFWSU), and the traffic management units (TMU) in each ARTCC and designated level 5 terminals. The upgrading of the traffic management system is designed to improve air traffic system efficiency, minimize delays, expand services, and be more responsive to user requirements.

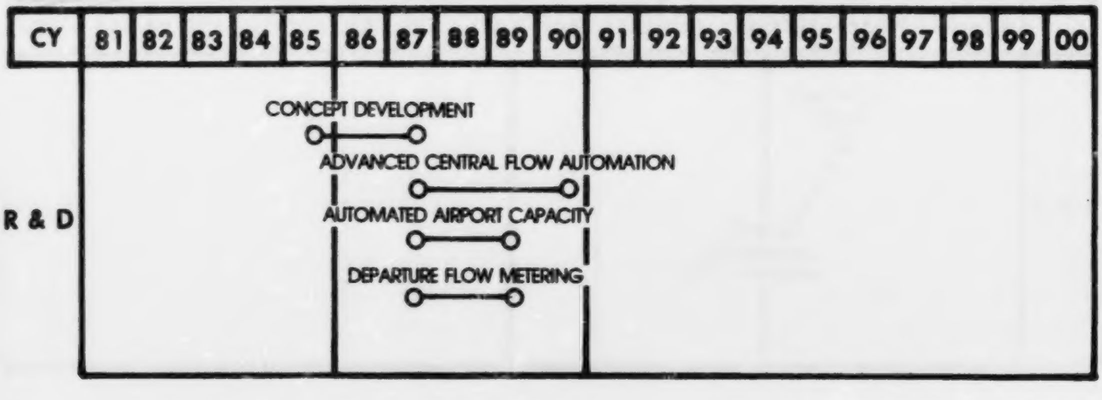
Approach: The present flow control and altitude reservation system will evolve using a three-phase approach: (1) Phase I completed by second quarter of FY-84, (2) Phase II completed by the end of 1986, and (3) Phase III (advanced traffic management system) under development through I993.

Phase I is nearing completion, includes: (1) replacement of the 9020A computer system at Jacksonville, Florida , with the IBM 4341 computer located at the FAA Technical Center; (2) relocation of CARF and the automation staff to FAA headquarters; (3) implementation of a data communications system to interface users and NAS 9020 computers at each ARTCC in a two-way data mode; (4) installation of upgraded data terminals in CFCF; (5) improvement of departure release time software; and (6) implementation of a static en route sector load software at flight level 240 and above.

Phase II is to be completed from CY-84 through CY-86 and focuses on 12 specific areas. High priority is placed on each of these during this critical poststrike period while the air traffic control full performance level population is growing. They are as follows:

- Traffic management unit (TMU) enhancements—upgraded terminals.
- En route sector loading.
- En route metering IA/II.
- Update of AAS and AERA specifications.
- Estimated departure clearance (time) (EDCT) program enhancements.
- Establishment of enhanced ATC system graphic capability.
- Interface CARF automation with the traffic management system.
- Establishment of data communications links with user organizations.
- Implementation of computer runway configuration management system.
- Implementation of system for traffic management monitoring and measuring.
- Implementation of en route sector sequencing automation program.

SCHEDULE



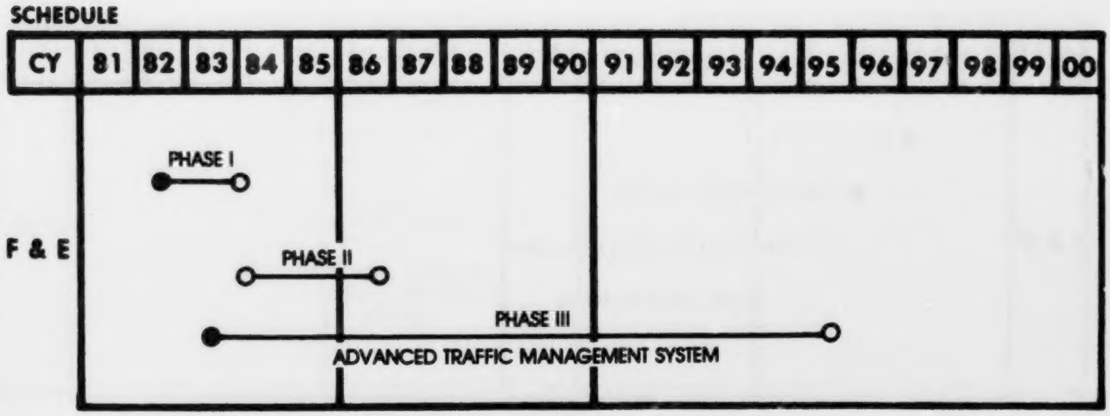
- Implementation of random route graphics.

Phase III will fully integrate the advanced automation system with the traffic management system to provide all planned flow management functions. This phase will be implemented in the mid-1990's.

Products: The traffic management system design will provide an integrated system highly responsive to existing traffic situations and allow the traffic management system to evaluate the total ATC system impact of strategies which may be employed.

Related Projects/Activities:

- FSS automation.
- AERA.
- NADIN.
- Weather programs—the CFWSU will require data from the CWP
- National radio communications system.
- Area navigation flights in a sector.



PROJECT 7: Modern ATC Host Computer

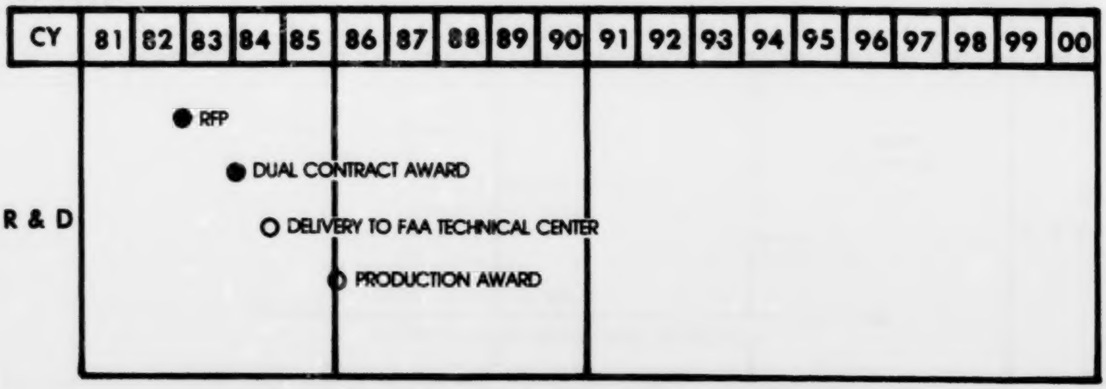
Purpose: The purpose of the computer modernization project is to provide needed computer capacity for the present en route systems as early as is practicable and improve computer reliability and availability. The modernization consists of the implementation of a host computer which is the first step of the advanced automation program. This first step will preclude problems associated with the capacity and capability limits of the current automation system. It is required to support the transition to the future air traffic control system.

Approach: The present IBM 9020 computers will be replaced with instruction-compatible host computers. Minimum changes will be made to the existing en route system software to enable it to run in the host computers. The host computer with en route software will be thoroughly tested at the FAA Technical Center to ensure that it operates correctly and reliably. Then, the computers will be installed in the en route traffic control centers, replacing the 9020 computers and interfaced with the present display channel systems and peripheral adapter modules.

The scope of the computer modernization program includes:

- Expansion or modification of existing ARTCC building to accommodate the host computer and provide space for implementation of the initial sector suite in a sterile environment.
- Replacement of all 9020A and D central computers.
- Modification of en route software to operate in the new host computers.
- Replacement of system support facilities.

SCHEDULE



The transitioning of the new host computer into the operational system must not disrupt air traffic control in the en route system. During transition to the host computer, it will be possible to revert back to 9020 operation in case of extended host failure.

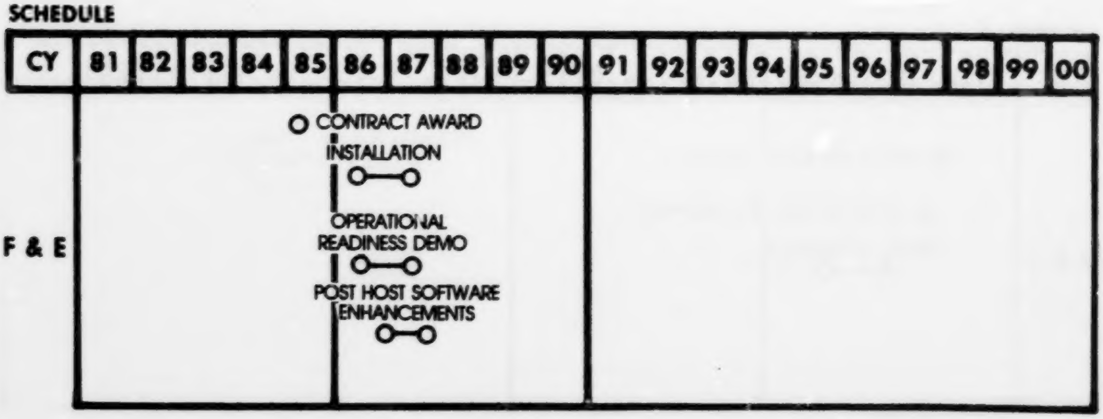
Products:

Host computers will be provided for:

- 20 contiguous en route sites.
- 2 support facilities (FAA Technical Center and FAA Academy).
- 2 as government-furnished equipment (GFE) to the advanced automation system contractors (1 to each contractor).

Related Projects/Activities:

- FDIO and enhanced DARC/9020 interface software must be delivered to the field in a 9020 software package and, subsequently, rehosted and delivered with the host operational implementation.
- The following post-host software enhancements will be incorporated prior to AAS: ERM II (1987), conflict resolution advisory (1987), and conflict alert IFR/VFR Mode C intruder features (1987).
- The host computer will interface with the advanced automation system.
- The implementation of the host computer is the first transition step in the FAA's plan for full implementation of the advanced automation system and area control facilities.



PROJECT 8: En Route Metering II (ERM II)

Purpose: The primary objective of en route metering is to organize traffic in the en route airspace so that congestion and delays will be kept to a minimum. ERM II will provide automation aids which will assist ARTCC controllers in routing traffic into the terminal area at a rate consistent with the airport acceptance rate. The automation will also assist the controller in coordination with adjacent centers in managing aircraft to absorb necessary delays in a fuel-efficient manner at higher altitudes.

Approach: Using functional specifications, a support contractor will design, program, and test modifications which incorporate en route metering into the operational en route computer program. The modifications will be incorporated in the field version of the program that will be implemented in the host computer. Operational testing will be done at the FAA Technical Center before field implementation.

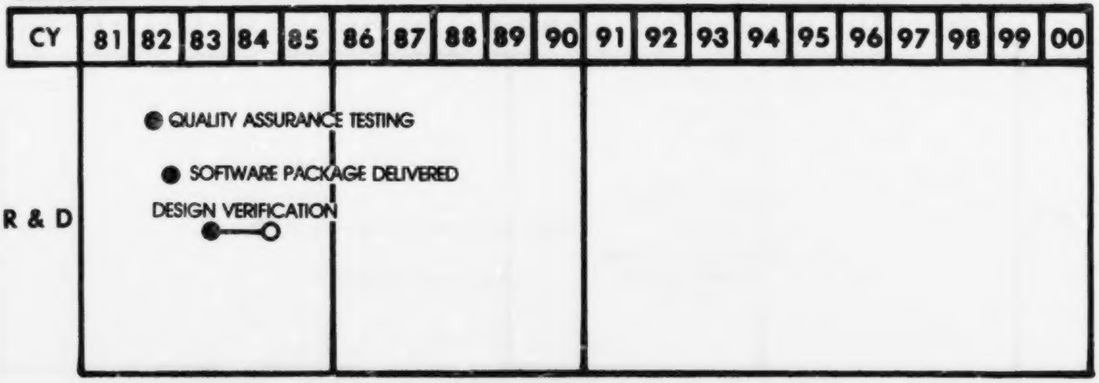
Products: One computer program adaptable for use at host-equipped air route traffic control centers.

Related Projects/Activities:

- Modern ATC Host Computer—the capacity of the host computer is required before implementing the software package.

- Traffic Management System — ERM II will be integrated with traffic management system functions to compute dynamic precise acceptance rate values and to incorporate departure demands at other airports into the arrival metering schedule.

SCHEDULE



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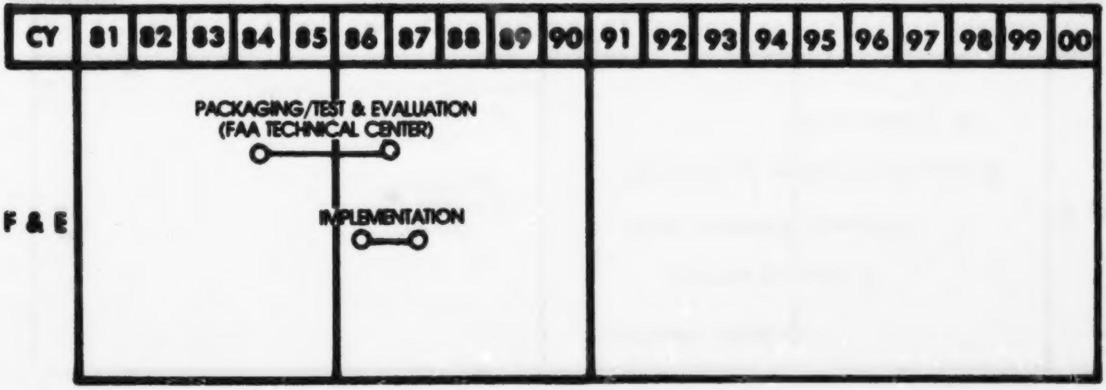
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IMPLEMENTATION

PROJECT 9: Conflict Resolution Advisory Function

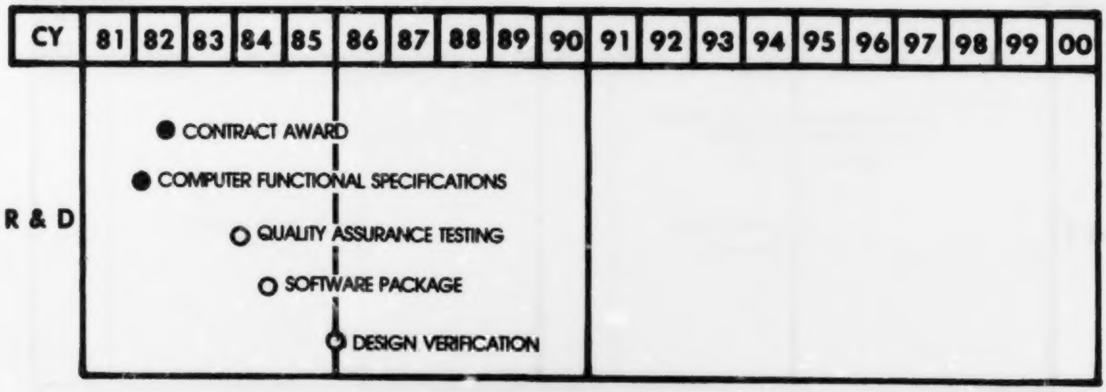
Purpose: This project will provide automation aided assistance to en route radar controllers in resolving potential conflicts when violation of separation minima is about to occur. The conflict resolution advisory function is designed to provide the radar controller with a display of alternative resolution of conflicts detected by the conflict alert function. The prime objective of conflict resolution advisories is to reduce the number of operational errors (violations of en route separation standards).

Approach: Using functional specifications, a support contractor will design, program, and test modifications incorporating the conflict resolution advisory function into the operational en route computer program. Following development, the modified computer programs will be evaluated in the FAA Technical Center system support laboratory. When evaluation is completed, the modified computer program will be implemented in the host computer.

Products: One computer program suitable for adaptation and use at 20 air route traffic control centers.

Related Projects/Activities: The capacity of the host computer is required prior to implementation. Conflict resolution advisory implementation is a transitional step toward similar function of AERA.

SCHEDULE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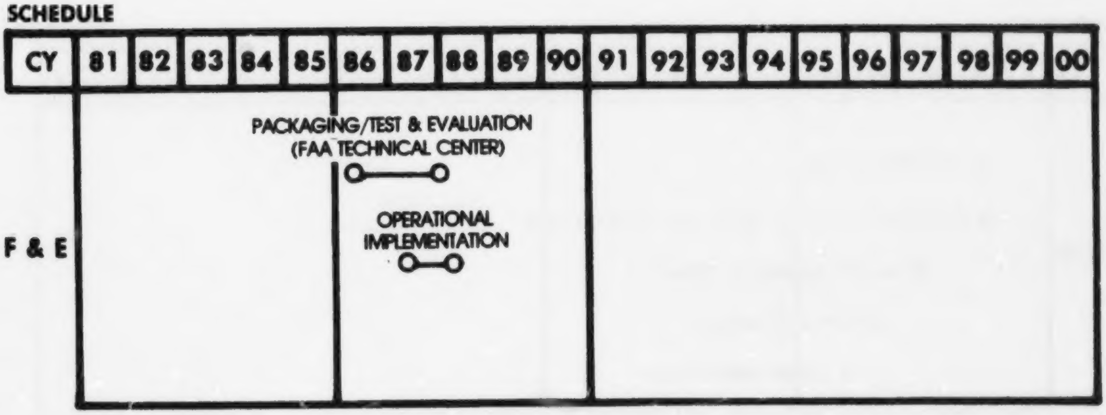
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PACKAGING/TEST & EVALUATION
(FAA TECHNICAL CENTER)
OPERATIONAL
IMPLEMENTATION

PROJECT 10: Conflict Alert IFR/VFR Mode C Intruder

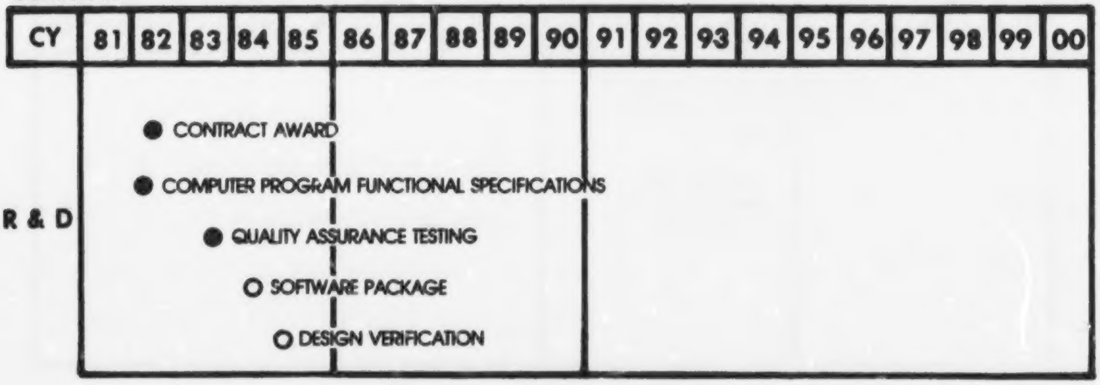
Purpose: This project will provide computer assistance to en route radar controllers to identify potential conflict situations between IFR aircraft and VFR Mode C equipped aircraft. The conflict alert IFR/VFR Mode C intruder function is an enhancement to the conflict alert function currently in use in the en route system. This software enhancement extends the conflict alert functions to include cases where IFR aircraft are approaching potential conflict situations with VFR aircraft that are equipped with altitude reporting (Mode C) transponders.

Approach: Experimental software to demonstrate the feasibility of this conflict alert enhancement function has been developed and tested. However, this experimental software has not been optimized for computer resource requirements and incorporation of functional changes. Using revised functional specifications, a support contractor will design, program, and test modifications incorporating the conflict alert IFR/VFR Mode C intruder function into operational en route computer programs. Following development and evaluation, which will be accomplished at the FAA Technical Center using the en route system support laboratory, the software will be upgraded to the latest field version and implemented in the host computer. The conflict alert function for IFR/VFR Mode C intruders probably will be used only for traffic above a flight level of 12,500 feet.

Products: One computer program suitable for adaptation and use at all 20 air route traffic control centers.

Related Projects/Activities: The capacity of the host computer is required prior to implementation.

SCHEDULE



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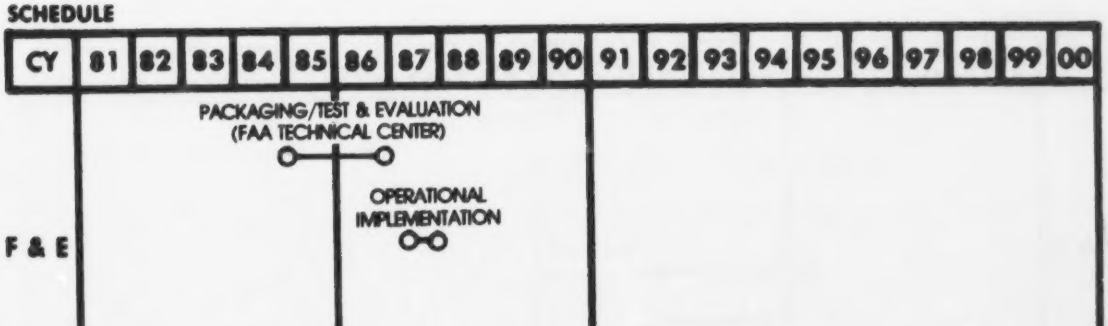

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PACKAGING/TEST & EVALUATION
(FAA TECHNICAL CENTER)
OPERATIONAL
IMPLEMENTATION
F & E

PROJECT 11: Voice Switching and Control System (VSCS)

Purpose: This project will provide a voice communications system which performs the intercom, interphone, and air-ground voice connectivity and control functions needed for air traffic control operations in an ACF. The VSCS must satisfy the voice communications reconfiguration and service availability needs of the ACFs, reduce lease services costs, increase modularity and growth capability, and increase controller productivity.

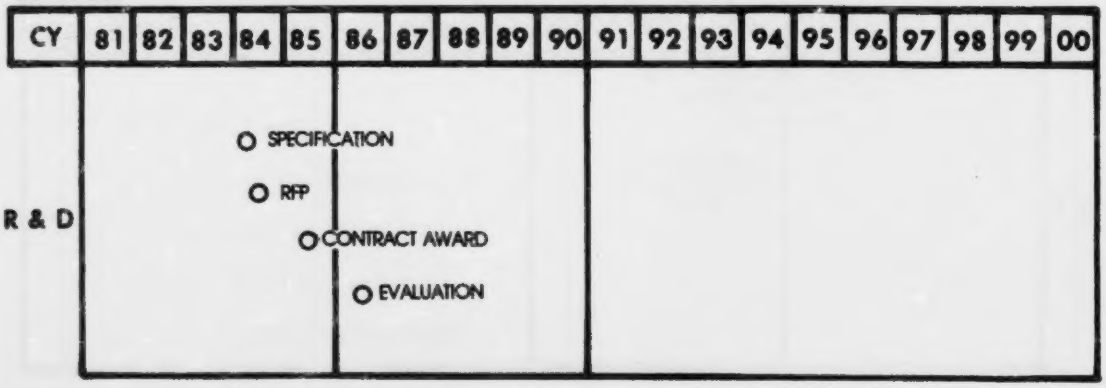
Approach: The VSCS switching and control system will use existing off-the-shelf technology adapted to meet FAA requirements. Two competing systems will be procured and evaluated prior to specification and award of a contract for the final 26 systems. The VSCS contractor will design position equipment compatible with the data entry technology and techniques used for the sector suite. The position equipment will be designed to fit into space allocated within the sector suite console-in essence, a drop-in panel. The advanced automation system (AAS) contractor will position the voice communications equipment and display devices to best fit the total man-machine interface and console design. An interface is required with the AAS for reconfiguration and status reporting purposes. A set of predetermined reconfiguration maps will be embedded in the VSCS. Capability to modify or create new reconfiguration maps from designated VSCS positions shall be provided.

Products:

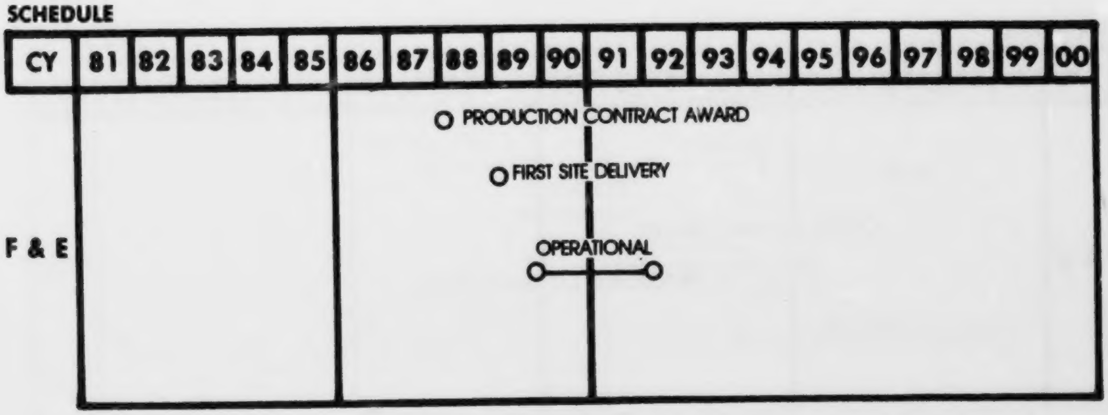
- One system per ACF, and position equipment for each sector position.
- Two systems for the FAA Technical Center and one for the FAA Academy.

Related Projects/Activities: Radio Control Equipment, ICSS, Tower Communications System, NADIN, and AAS establishment. VSCS must be available and installed concurrently with the initial sector suites. This project appeared in the 1983 edition in Chapter V, Interfacility Communications Systems.

SCHEDULE



SCHEDULE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PRODUCTION CONTRACT AWARD
FIRST SITE DELIVERY
OPERATIONAL

PROJECT 12: Advanced Automation System

Purpose: The purpose of the advanced automation system is to provide a total automation system that includes the controller sector suite, new computer software, and new processors to augment the host computers. The advanced automation system will provide the capacity to handle the projected traffic load through the 1990's and beyond, the capability to perform all of the new functions to be introduced into the ATC system through the mid-1990's, increased productivity through introduction of new sector suites at the earliest practical time, a high degree of reliability and availability, and the capability for enhancement to perform other functions subsequently introduced into the system.

Approach: The advanced automation system will be designed through a top down, evolutionary, total system approach. This design will be in parallel with host comptuter development. Transition to the AAS will consist of three steps at the ARTCCs in the continental United States. The first step will be the replacement of the 9020 computers at the en route centers with new host computers described elsewhere in this document. Step two will be the implementation of initial sector suite; and step three, full AAS.

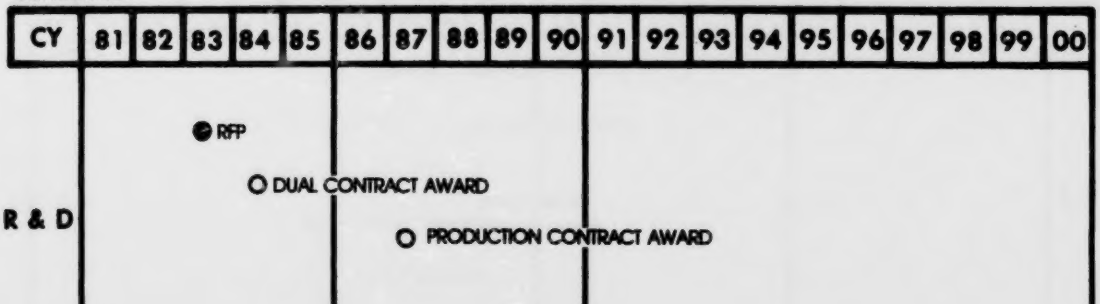
The sector suite will consist of common controller work stations used for both en route and terminal functions. It will be designed so that many common elements can be used in a tower suite. The sector suite will be initially installed in en route facilities served by the host computers and the 9020 software to provide increased productivity.

The initial sector suite will be installed in a sterile environment previously provided by the expansion of ARTCC buildings to accommodate the host computer and by reclaiming a part of the existing control room. After transition to the initial sector suite, the old control room will be refurbished to accommodate sector suites necessary for terminal consolidation.

During the final transition step, new computer software and new processors to augment the host computers will be introduced. Software functions that are now unique to the terminal air traffic control systems will be incorporated into the new software to support the area control facilities. All remaining elements of the current en route automation hardware and software will be replaced.

The full advanced automation system will make possible the integration of en route and terminal operations in the area control facilities. The tower position consoles will be installed when terminal radar control is operationally integrated into the area control facilities.

SCHEDULE



Products: The scope of the AAS project includes construction and site preparation that is specifically required for the implementation of the AAS at area control facilities.

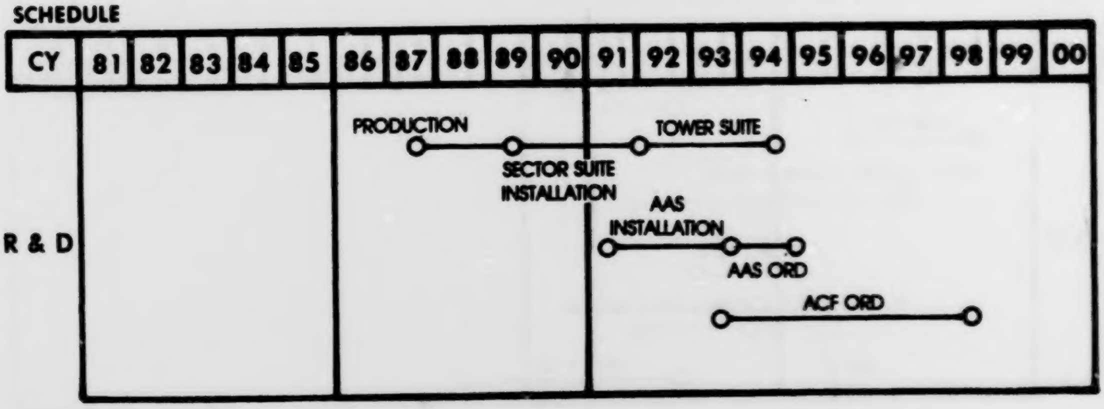
- Advanced automation system design.
- Advanced automation system software.
- Advanced automation system computer hardware.
- ACF position equipment:

Operational positions	1,258
Metering	69
Training	275
CWSU	23
Traffic management unit	23
E-Deck	23
Area supervisor	98
Airspace	23
Oceanic planning	4

- Tower suites (300 ATCT).
- Support facilities:

Site spares/ACF	50
FAA Academy	30
FAA Technical Center	66
FAA Depot	15

Related Projects/Activities: The modern ATC host computer project is the first transition step of the advanced automation program. Past development projects will provide input to the sector suite and tower suite designs. The area control facilities project will determine the location of advanced automation systems. The VSCS and Tower Communications System projects will provide the voice switching and communications necessary for AAS implementation. The AAS design will include AERA I functions and facilitate later implementation of AERA II/III functions.



PROJECT 13: Automated En Route Air Traffic Control (AERA)

Purpose: This project will provide interactive software for use by sector and traffic management system personnel which will: (1) permit most aircraft on IFR flight plans to fly fuel-efficient profiles, (2) increase safety of the system by reducing the potential for operational errors, (3) increase system capacity by integrating en route metering with local and national flow control, and (4) increase controller productivity by increasing the number of aircraft and volume of airspace that a control team can safely manage.

Approach: AERA will be developed in six discrete steps which will lead to three implementation packages. AERA I consists of two development steps, 1.01 and 1.02, and is designed primarily to provide user benefits and will be introduced with the advanced automation system software. AERA I is based on developing a 4-D flight path trajectory estimation model to support such features as:

- Flight path conflict probe which will predict potential violation of separation standards.

- Restricted airspace probe which will detect potential violations of restricted and special use airspace and, later, severe weather areas.

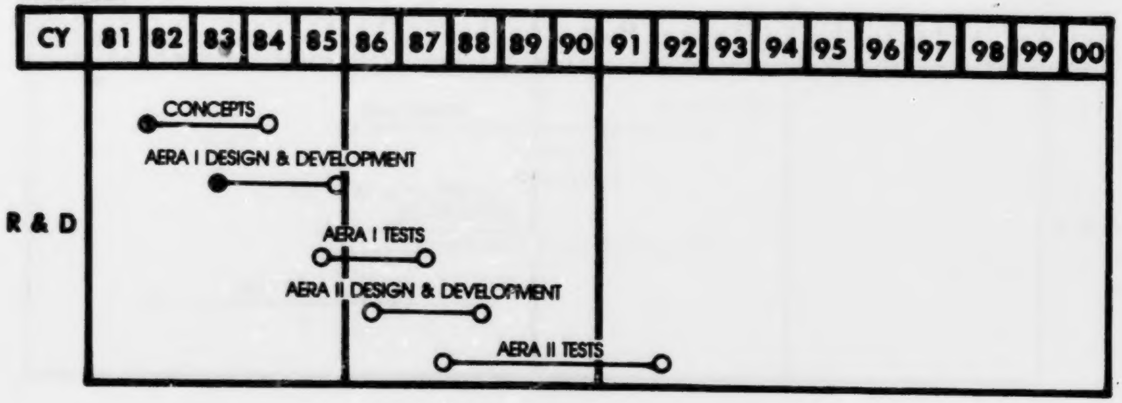
- Workload probe which predicts sector workload and assists supervisors in balancing sector staffing.

- Conflict-free metering (an AERA 1.02 function) which will couple the flight plan conflict probe with en route metering to ensure that metering actions result in fuel-efficient profiles.

- Reminder function to prompt controllers of planned altitude changes.

AERA II, which consists of three development steps, will be the first enhancement to the advanced automation system and is aimed primarily at increasing controller productivity. It will extend the AERA I functions from detecting potential conflicts to providing the controller with potential resolutions. It will also extend the planned action advisory function to include all planned actions, such as planned conflict resolutions, metering actions, etc., and will introduce the concept of computer-generated data link clearances.

SCHEDULE



AERA III represents the final AERA development step and is intended to extend the AERA capability from automatic clearance generation to automatic clearance delivery via data link.

Each AERA development package will undergo a series of rigorous engineering and validation steps consisting of concept and algorithmic development, operational suitability evaluations, computer performance functional specification development, and field implementation. The AERA test bed provides the necessary capability to assess the validity of each AERA function and to perform the operational suitability evaluations with air traffic control specialists.

Products: Algorithmic specifications for the AERA 1.01 functions were developed in FY-83 and algorithmic specifications for AERA 1.02 are scheduled for completion in FY-84. AERA I research and development will be completed in early FY-86 and operational development will be accomplished as part of the advanced automation system. AERA II and III computer functional performance specifications are scheduled for completion at approximately 1-year intervals following AERA I.

Related Projects/Activities:

- Advanced Automation System (AAS)—the AAS will include AERA I functions and facilitate later implementation of AERA II and AERA III functions.

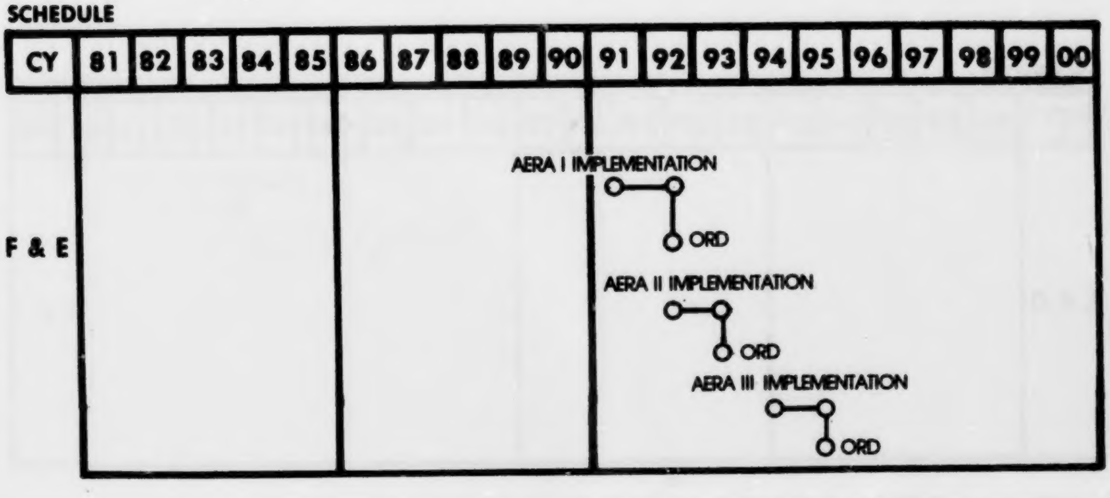
- Traffic Management System—AERA will provide key en route traffic conditions and prediction data to the traffic management system. The upgraded traffic management system will be integrated with AERA to keep both short- and long-term traffic planning coordinated.

- En Route Metering—AERA will incorporate and execute the en route metering and delay absorption plans developed by en route metering.

- Weather projects—products provided by the center weather service unit will be utilized by AERA. More accurate wind data than is currently available, provided by the weather projects, will improve AERA performance.

- Mode S/Data Link—Mode S/data link, interfaced through AAS, will provide automated controller/pilot data and advisory interchange which will enhance the AERA performance.

SCHEDULE



PROJECT 14: Integration of Nonradar Approach Control into Radar Facilities

Purpose: This project will expedite movement of air traffic by integrating the volume of air traffic now handled by nonradar approach control facilities into facilities with radar. Integration will reduce the total number of operational control positions and improve service to users by eliminating delays induced by use of nonradar procedures and interfacility coordination.

Approach: Existing radar positions at radar facilities can provide radar vectors to the final approach course navaids, fixes, or initial approach altitude where feasible. By using radar vectors instead of nonradar control methods separation criteria can be reduced by 40 percent resulting in greater capacity and fewer control positions.

Products: Seven nonradar control facilities have been integrated into existing radar facilities. An additional 28 nonradar facilities will be integrated over the next 30 months. Productivity has increased in all facilities that have been integrated.

Related Projects/Activities: None.

SCHEDULE

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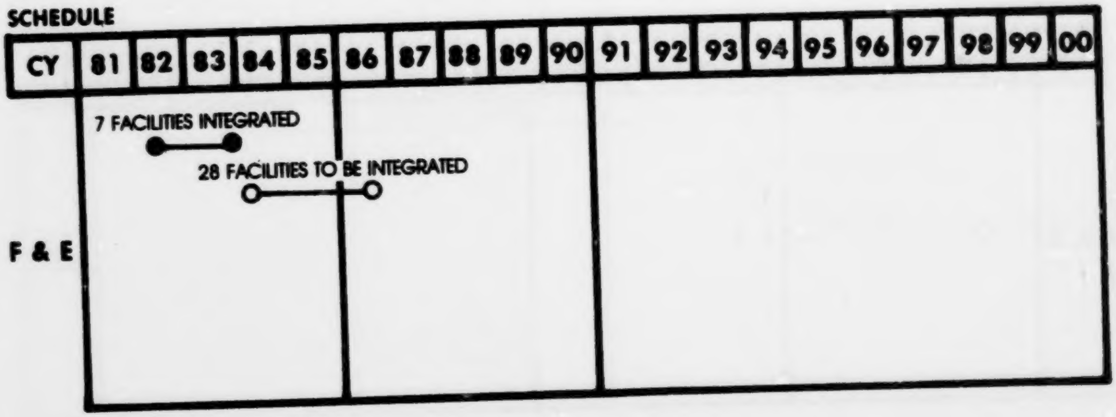
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7 FACILITIES INTEGRATED
28 FACILITIES TO BE INTEGRATED
F & E

PROJECT 15: Area Control Facilities (ACF)

Purpose: This project will improve air traffic control service to users, increase Air Traffic and Airway Facilities personnel productivity, and absorb growth through consolidation of air traffic control facilities. Additionally, creation of ACFs minimizes the cost of providing identical advanced automated features to en route and terminal controllers at a large number of facilities.

ACFs will have realigned boundaries based primarily on traffic flows throughout large geographic areas, accommodating arrival, departure, and en route control in one type of facility. All necessary control towers will remain in existence, but radar control facilities will be reduced from 210 (22 ARTCCs and 188 TRACONs) to 23. The 23 ACF locations include the 20 contiguous ARTCCs, Honolulu ARTCC, Anchorage ARTCC, and the New York TRACON.

Approach: The ACF project will be accomplished in two primary phases with numerous subphases or programs in each phase.

- Phase I consists of those activities leading to the establishment of the first ACF and is called "Pre-ACF Activities." Such programs as the ARTCC building expansion/modernization, installation of the host computer, upgraded software, initial sector suites, new communications networks, installation and commissioning of AAS, and increased training will be completed during this phase. Phase I is currently scheduled to begin in 1984 and be completed in 1992.

- Phase II will be the actual establishment of ACFs throughout the country and is called "ACF Establishment Activities." These activities will consist of reconfiguring existing cab consoles and installing tower suites, refurbishment of radar control rooms and environmental support systems in the centers, relocation/consolidation of approximately 188 TRACONs, and remoting of radar and communications.

Phase II will begin in 1993 and be complete when the last scheduled TRACON is consolidated and operational in an ACF—presently scheduled for 1998.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

Products:

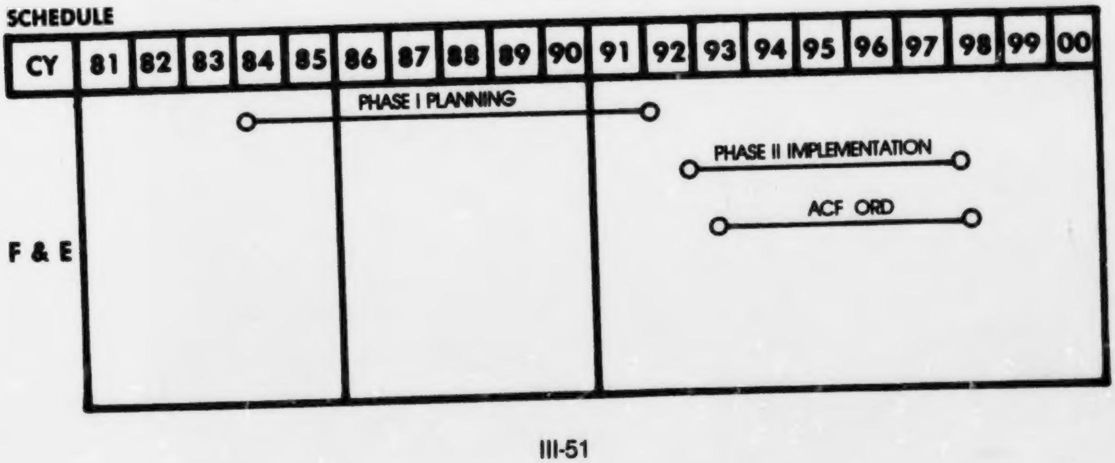
- Twenty-three area control facilities providing arrival, departure, and en route control functions, resulting in more efficient/effective air traffic management by improved procedures and operations; fewer communications transfers; optimized severe weather avoidance procedures.

- Fuel savings will accrue to users because of fewer altitude restrictions, better profile descent/en route metering, and increased direct routing.

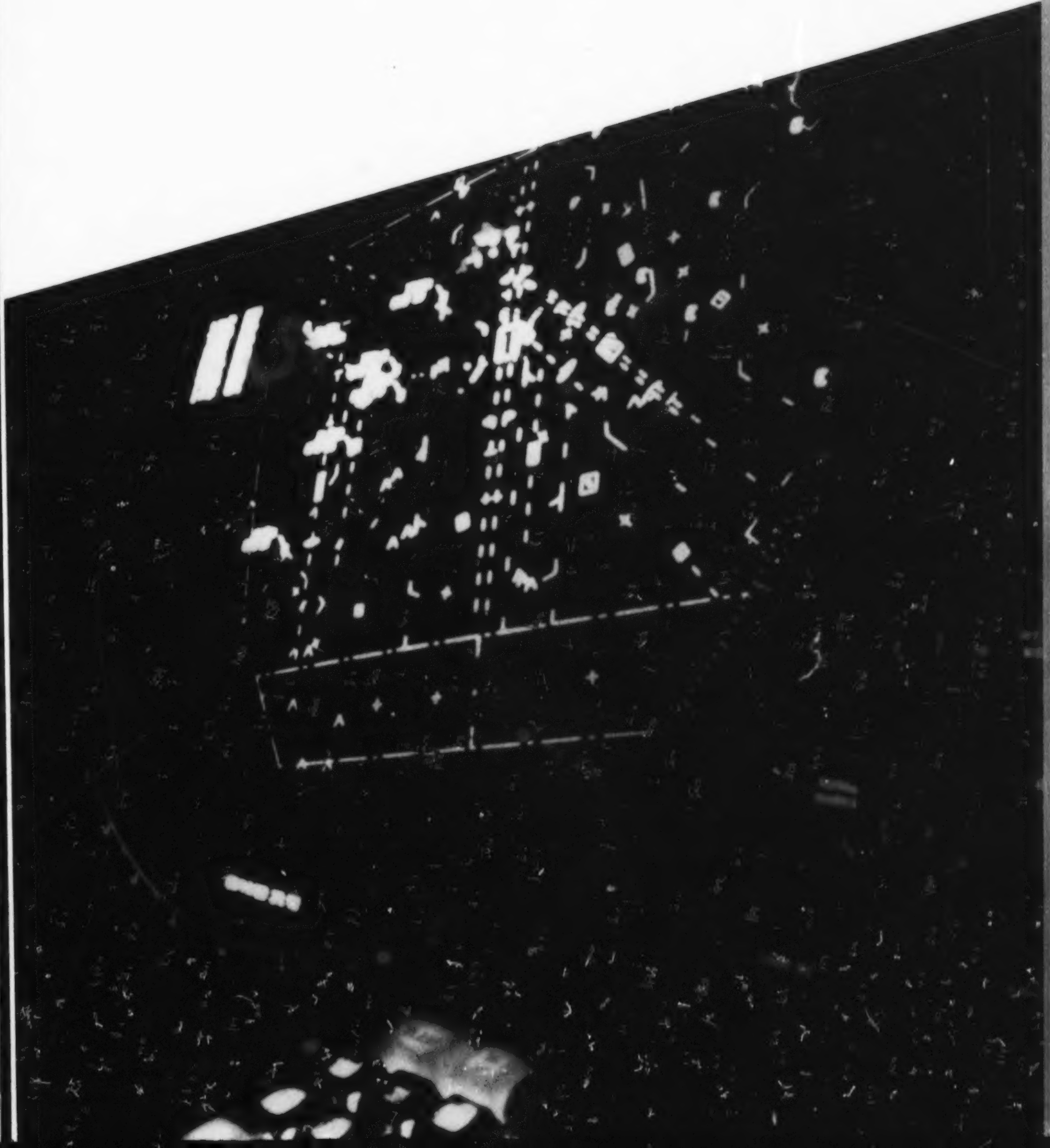
- Higher productivity will be realized because of increased controller workload, optimized use of advanced automation, and a functionally integrated controller work force.

- Significant cost savings will result due to fewer buildings and grounds to maintain, reduced leased services cost, and fewer automation systems to maintain.

Related Projects/Activities: ARTCC building expansion/modernization, Advanced Automation System (AAS), sector suites, radar remoting and digitizing, VSCS, communications networking and remoting, navaids networking, software development, tower suites, military liaison, and weather programs.



TERMINAL



TERMINAL SYSTEMS

The three major types of facilities used in terminal air traffic control are the airport traffic control tower (ATCT), terminal radar approach control (TRACON), and terminal radar approach control in the tower cab (TRACAB). Located on airports, the ATCTs are the most common, as well as the most visible. Their purpose is to separate aircraft, sequence aircraft in the traffic pattern, expedite arrivals and departures, separate aircraft on the landing areas, and provide clearance and weather information to pilots.

The second most common are the TRACONs that control airspace around airports with moderate-to-high-density traffic. TRACON controllers separate and sequence both arriving and departing flights. Normally, each TRACON is associated with one ATCT and located within the same building. However, a TRACON may be remotely located and may serve more than one ATCT. The third type, the TRACAB, serves a function similar to that of the TRACON. TRACABs are located within tower cabs at airports with lower-density traffic.

All terminal air traffic control facilities are equipped with radio communications to aircraft; telephone communications to air route traffic control centers and flight service stations; and have a variety of equipment for observing, detecting, receiving, and displaying weather information. Radios and telephones are major tools of the terminal controller.

Terminal ground-to-air communications are conducted with VHF or UHF transmitters and receivers. Current ATC ground-to-air communications require many frequency changes as aircraft move through the system.

Terminal ground-to-ground communications use a variety of old switching systems. These systems are leased and range in complexity from simple systems used in many small ATCTs to Western Electric 301 and 301A systems used at TRACONs. (Plans for improving the remote transmitter and receiver portion of the ground-to-air communication system are covered in Chapter IV on Ground-to-Air.)

At nearly all terminal ATC facilities, computers are used to relieve the controller of routine tasks and give the controller information that assists in maintaining aircraft identification. In addition, information such as altitude and aircraft speed, which must be provided by the pilot in a nonautomated environment, is displayed on the controller's screen by means of alphanumeric symbology.

The TPX 42 equipment is the least sophisticated of the terminal automation systems. It is a nonprogrammable, numeric beacon decoder system. That is, information from an aircraft's transponder is decoded and displayed for the controller in numeric form along with normal radar data. It provides aircraft transponder code and altitude information for suitably equipped aircraft. TPX 42 is used at lower-activity terminal radar facilities.

The automated radar terminal system (ARTS II) is a programmable, nontracking data processing system. Although it does not provide tracking, the ARTS II does provide meaningful information such as aircraft identification and altitude to the controller. Like TPX 42, ARTS II derives its information only from the aircraft's transponder. ARTS II may be interfaced with the ARTCC computer for the automatic exchange of information. ARTS II is used for facilities having low-to-medium activity. At present, ARTS II has no unique software other than minor adaptations to the basic operational program.

The automated radar terminal system (ARTS III) is a programmable, beacon tracking system. Based on information from the aircraft's transponder, the ARTS III detects, tracks, and predicts the position of aircraft in the terminal area. The information is displayed on the controller's radar scope by means of computer-generated symbols and alphanumeric characters, along with normal radar data. The computer displays aircraft identification, altitude, ground speed, and flight plan data. In addition, the ARTS III is interfaced with the ARTCC computer allowing the computers to exchange information.

At present, ARTS III is installed at medium-to-high-activity terminal facilities. Currently, there are two unique features provided by ARTS III through software. The first is the minimum safe altitude warning (MSAW). MSAW is a function of the ARTS III computer that will alert the controller when a tracked aircraft, with altitude reporting capability, is below or is predicted by the computer to go below a predetermined minimum safe altitude. The second is conflict alert. Terminal conflict alert (CA) is a computer function that alerts the controller to the situation that aircraft are in close proximity and possibly require attention or action.

The ARTS IIIA is an enhancement of the existing ARTS III designed to meet increasing traffic demands in terminal airspace. The ARTS IIIA is capable of tracking search radar targets as well as transponder-equipped aircraft. Thus, all aircraft that are within radar coverage of ARTS IIIA are candidates for computer processing. Like ARTS III, ARTS IIIA interfaces with the ARTCC's computer and contains the unique software features of MSAW and conflict alert.

Flight data entry and printout (FDEP) is not, in itself, automated equipment. However, it does provide an automated means of printing terminal flight progress strips. FDEP equipment interfaces with the ARTCC's computer and is used extensively throughout the system to automatically exchange flight data between ARTCCs and terminal approach control facilities and associated control towers.

Bright radar indicator terminal equipment (BRITE) is a supplemental radar display and alphanumeric system designed for use in the bright light environment of the ATCT cab.

The current terminal ATC system consists of over 400 ATCTs and nearly 200 TRACON/TRACABs.

THE NEW APPROACH

The objectives of the terminal system improvement plan are to maintain a very high level of safety, impose minimum constraints consistent with efficient use of the system and, at the same time, minimize FAA operations costs. This involves extended use of automation and reduction of the number of air traffic control facilities required. For the near term, this means making hardware and software improvements to existing ARTS automation systems and improvements to the supporting facilities and voice communication switching systems. Over the intermediate term, it involves replacement of the automation equipment to provide capacity for traffic growth, higher system reliability, and the addition of safety and efficiency enhancements.

The advanced automation system (AAS) will eventually be employed to improve air traffic productivity and provide significant cost-savings by reducing the multiple life-cycle costs for training, supply support, engineering and software associated with TPX 42, ARTS II, ARTS III, and ARTS IIIA. The computers will be common to those used for the en route functions and will employ common software. Sector suites used will be identical to those developed for en route functions and have identical processing capability.

A tower suite will be developed for ATCT use. It will use area control facility (ACF) sector suite components to the maximum extent possible, but will have unique displays for use in the space-limited, high-intensity light environment of the ATCT cab. Tower suites will draw on terminal, en route, and FSS data bases and will satisfy the traffic control requirements for radar flight position, intent and identity, flight data, weather data, and flow planning information.

In the long term, automation will be extended to create an integrated flow management system which will maximize airport capacity, smooth traffic flow, and reduce aviation fuel consumption. Consolidation of terminal air traffic control facilities will be undertaken to increase controller and technician productivity. The 188 TRACON/TRACABs which currently exist will be consolidated into 23 area control facilities (ACF) by the mid-1990's. The trend over the period will be to blend separate functions of terminal and en route air traffic control into these 23 ACFs. Supporting ATCTs will remain. Facility consolidation is expected to reduce the flight coordination between pilots and controllers and result in significant savings in equipment, personnel, and operating costs. Upgrading automation and voice communication switching will be the cornerstones of facility consolidation.

HOW THE SYSTEM WILL EVOLVE

NEAR TERM (TO 1985)

Near-term improvements will focus on higher productivity among air traffic controllers and Airway Facilities maintenance technicians and control of communication costs. The ARTS II will be upgraded. Software for conflict alert and MSAW safety improvements will be provided. Software to enhance conflict alert at ARTS III locations will be provided to reduce nuisance alarms. Enhancement of the controller training capabilities at ARTS III locations will be provided to expedite controller training.

ARTS III memory will be expanded to provide capacity for traffic growth. The capability to hand off aircraft and transfer flight data automatically between ARTS II and ARTCC facilities will be added to approximately 50 locations to reduce controller workload. A similar interface now exists at other sites. An automated ATC capability in the R-2508 restricted area of California has been created to prevent midair collision of civil and military aircraft.

Radar remoting to satellite ATCTs will be provided to reduce collision risk. Replacement of BRITE systems will have begun to improve technician productivity. TRACON BRITEs will be eliminated to improve working conditions. An integrated communications switching system (ICSS) will be provided to decrease leased communications costs. Power conditioning systems will be provided to ARTS III locations to improve reliability Research and development will start on the advanced automation system and computer modernization with a host machine.

Sustaining ATCT modernization and relocations will continue, with some consolidation of existing

TRACONs into center buildings. Design of ACF buildings has begun. Automatic terminal information service (ATIS) recording equipment will begin to be replaced with minimal maintenance models that will improve reliability and broadcast quality. Multichannel voice recorders will similarly begin to be replaced.

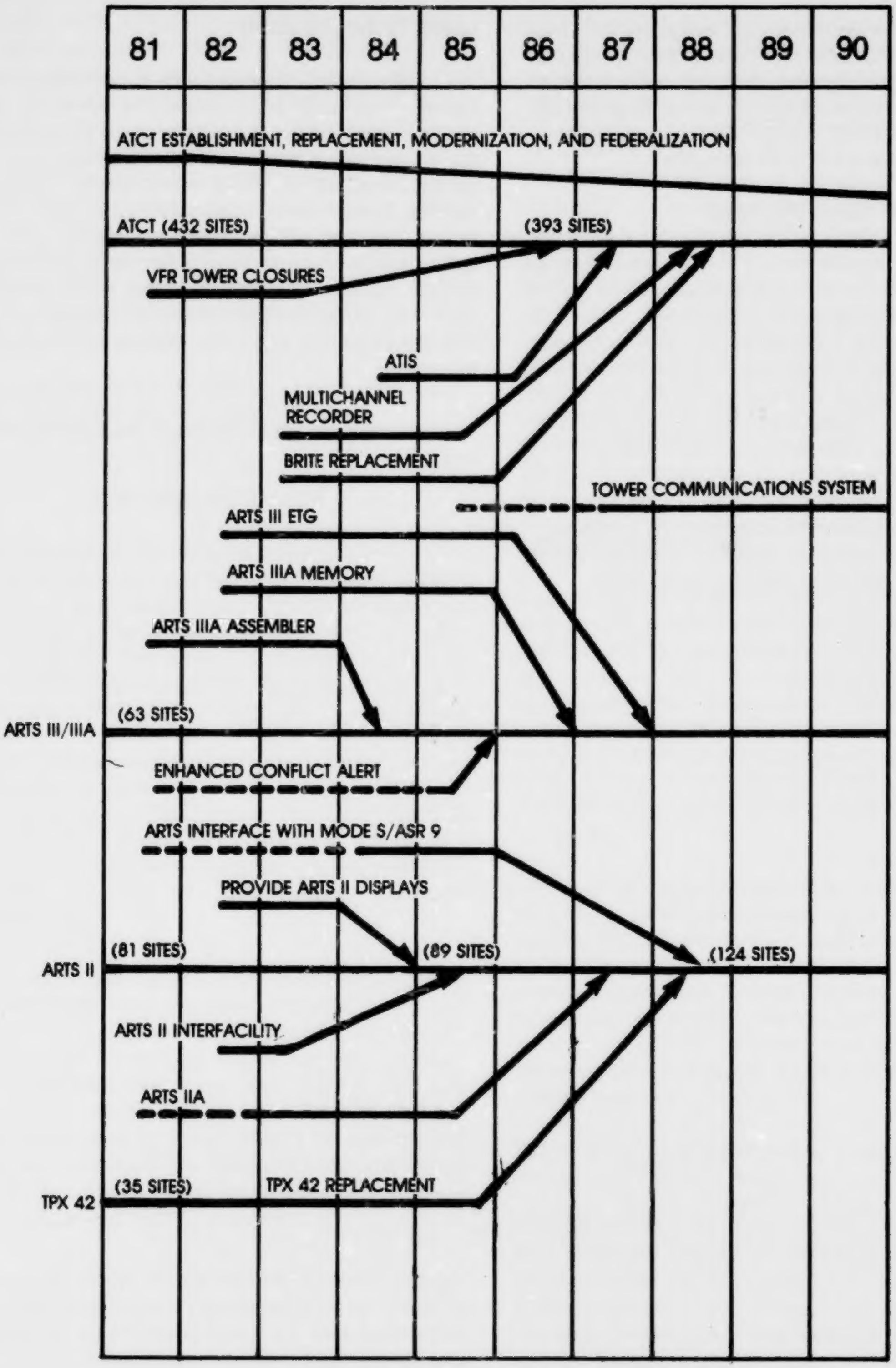
INTERMEDIATE TERM (TO 1990)

During the intermediate term, TPX 42's will be replaced and software for conflict alert and MSAW will be included as part of the acquisition. Construction for consolidated area control facilities will be well underway. Research and development will be completed for sector suites, tower suites, and voice switching and control systems. ATCT relocations and modernization will continue along with research into flow management. BRITE radar indicators with digital scan converters will have replaced obsolete equipment. Installation of BRITE in additional satellite control towers will be completed. ARTS will have been modified to accept higher-quality Mode S data and digitized radar input.

LONG TERM (TO 2000)

Over the long term, the FAA plans to complete consolidation into area control facilities. The advanced automation system, tower suites, and voice switching and control systems will allow operations personnel to handle increased traffic without a proportional increase in staffing. Tower communications switching systems will be upgraded at ATCTs. Improved weather products will be available at the sector suite. Computer software will be implemented for flow management products. Data link coverage will be extended down to 6,000 feet and will be utilized to provide weather and clearances to aircraft.

The following diagram and maps describe the evolution of the system.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ATCT ESTABLISHMENT, REPLACEMENT, MODERNIZATION, AND FEDERALIZATION
ATCT (432 SITES)
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VFR TOWER CLOSURES
ATIS
MULTICHANNEL RECORDER
BRITE REPLACEMENT
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ARTS III ETG
ARTS IIIA MEMORY
ARTS IIIA ASSEMBLER
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ARTS III/IIIA
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(81 SITES)
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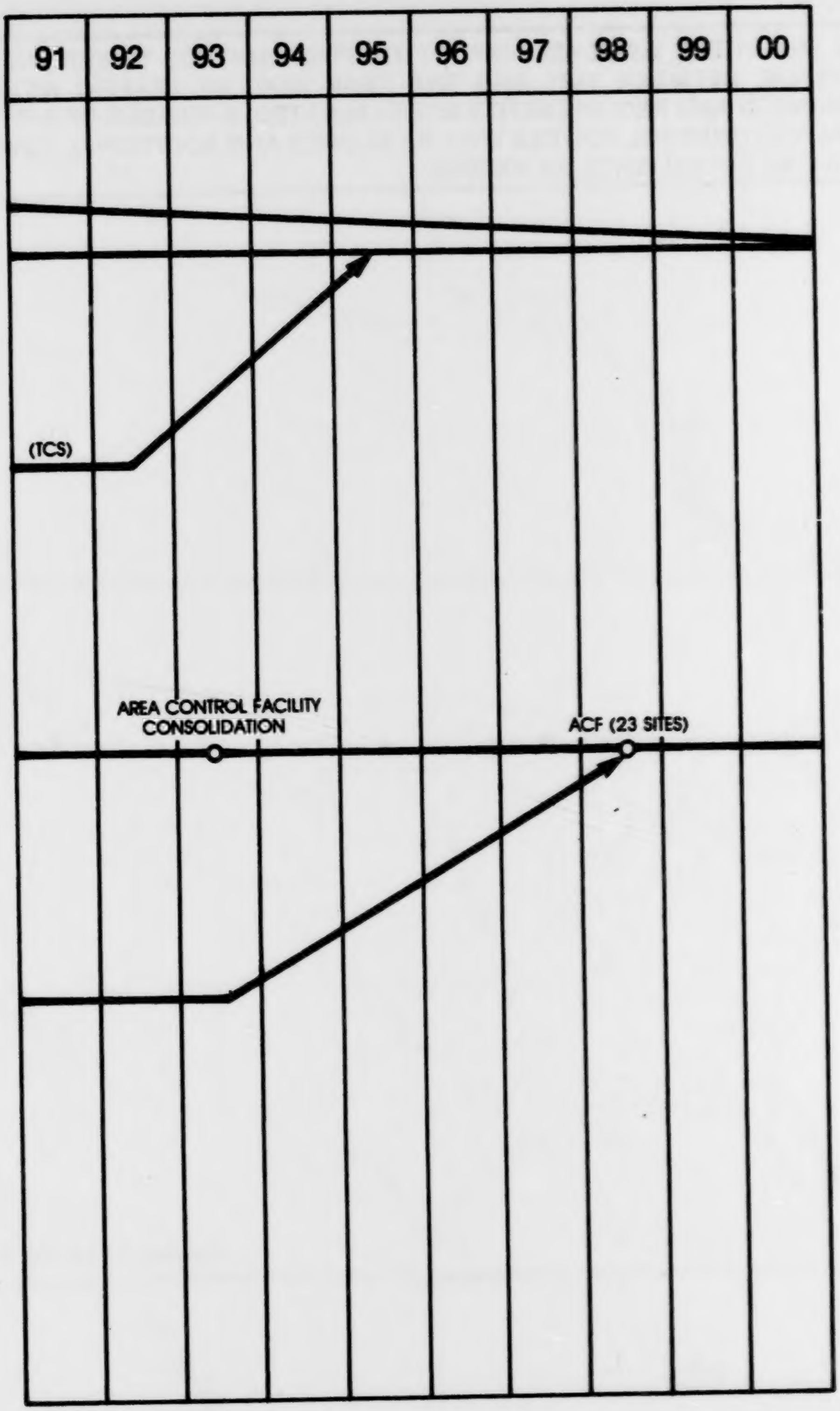
ARTS II
ARTS II INTERFACILITY
ARTS IIA
(35 SITES)
TPX 42 REPLACEMENT
TPX 42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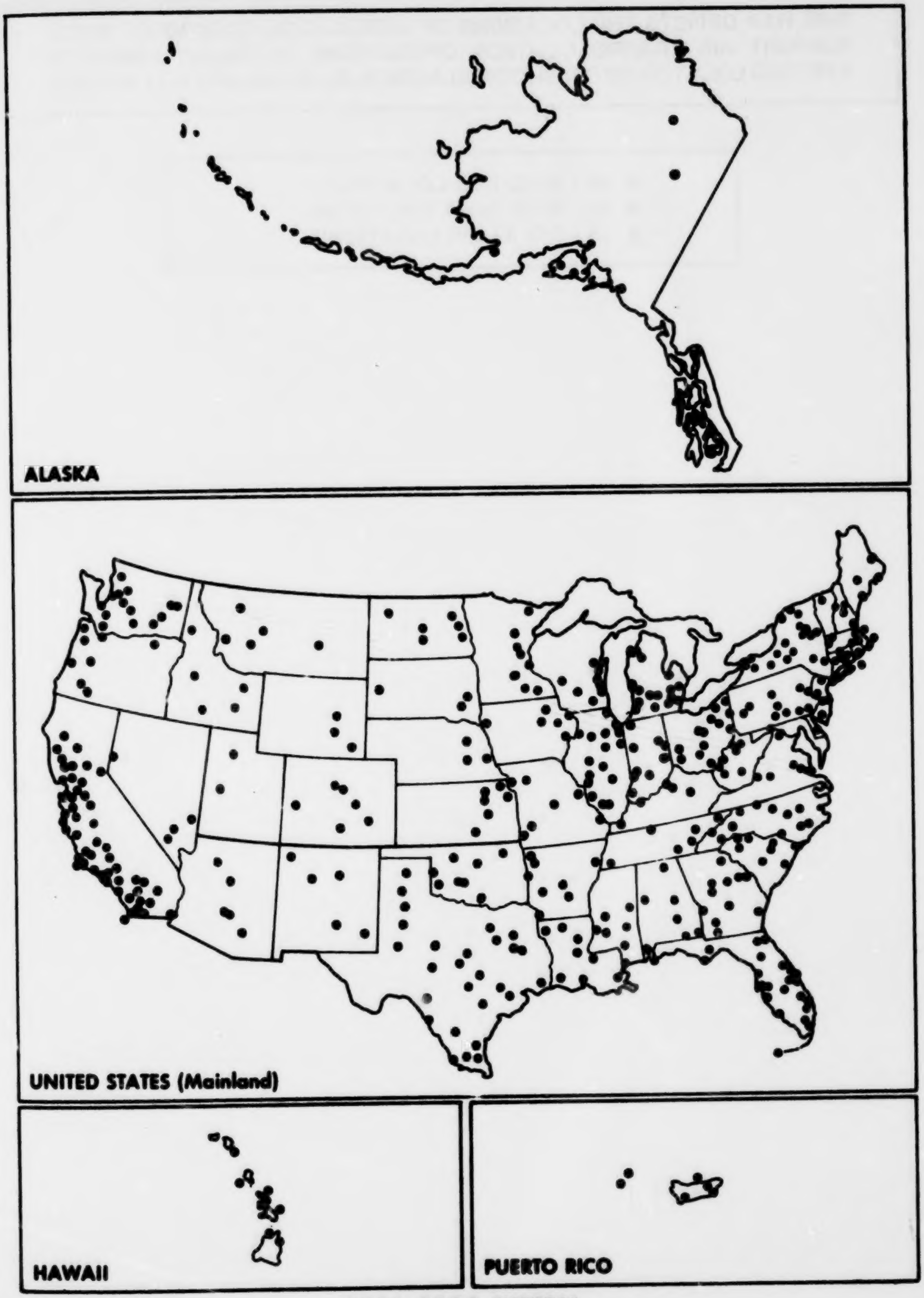
(TCS)
AREA CONTROL FACILITY CONSOLIDATION
ACF (23 SITES)

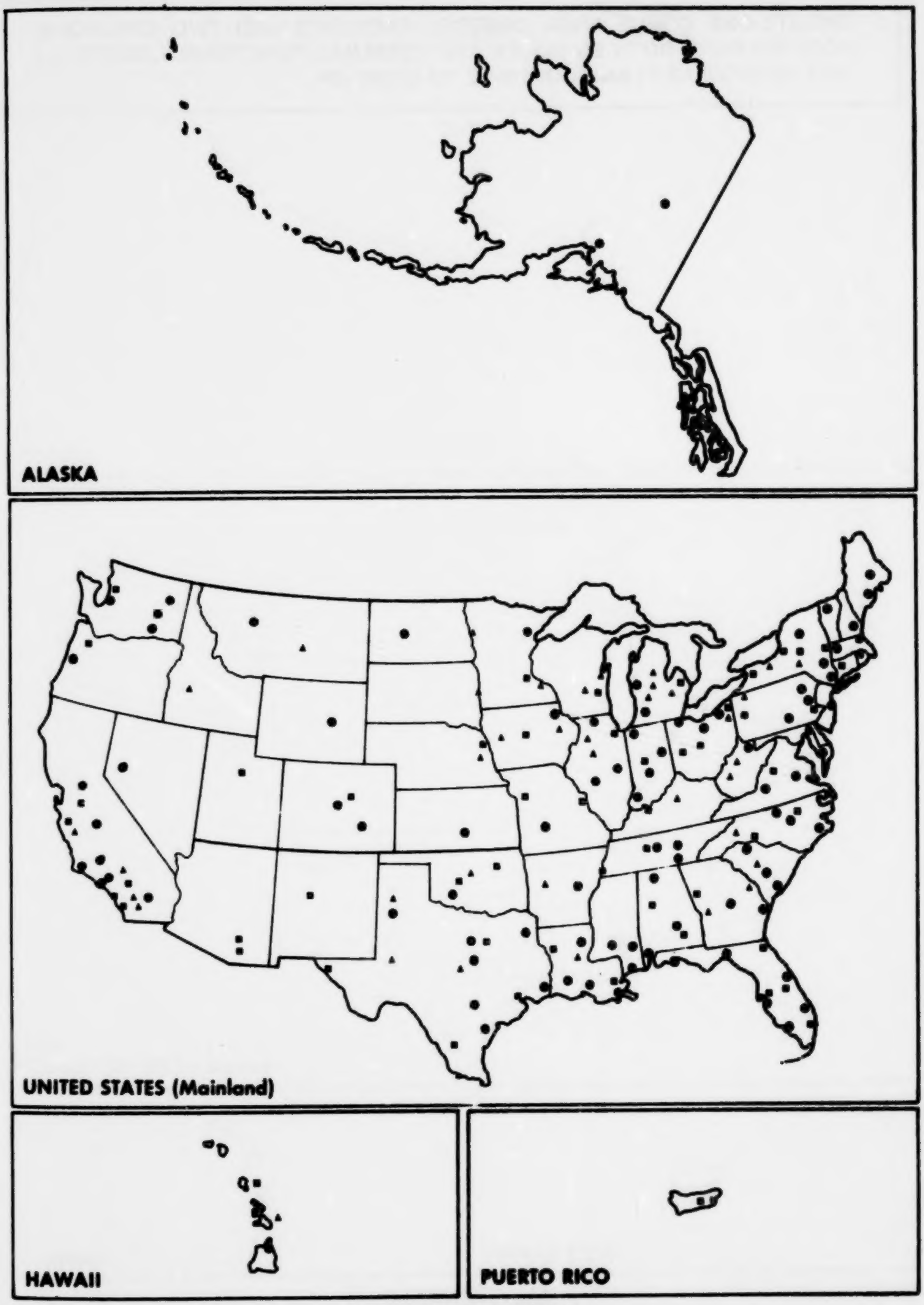
IN 1981 THERE WERE 432 AIRPORT TRAFFIC CONTROL TOWERS IN THE SYSTEM. BETWEEN 1981 AND THE YEAR 2000, AS TRAFFIC ACTIVITY CHANGES AND REQUIREMENTS ARE EVALUATED, A NUMBER OF AIRPORT TRAFFIC CONTROL TOWERS WILL BE CLOSED AND ADDITIONAL TOWERS WILL BE ESTABLISHED AS NEEDED.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1981-2000 SYSTEM
AIRPORT TRAFFIC CONTROL TOWERS

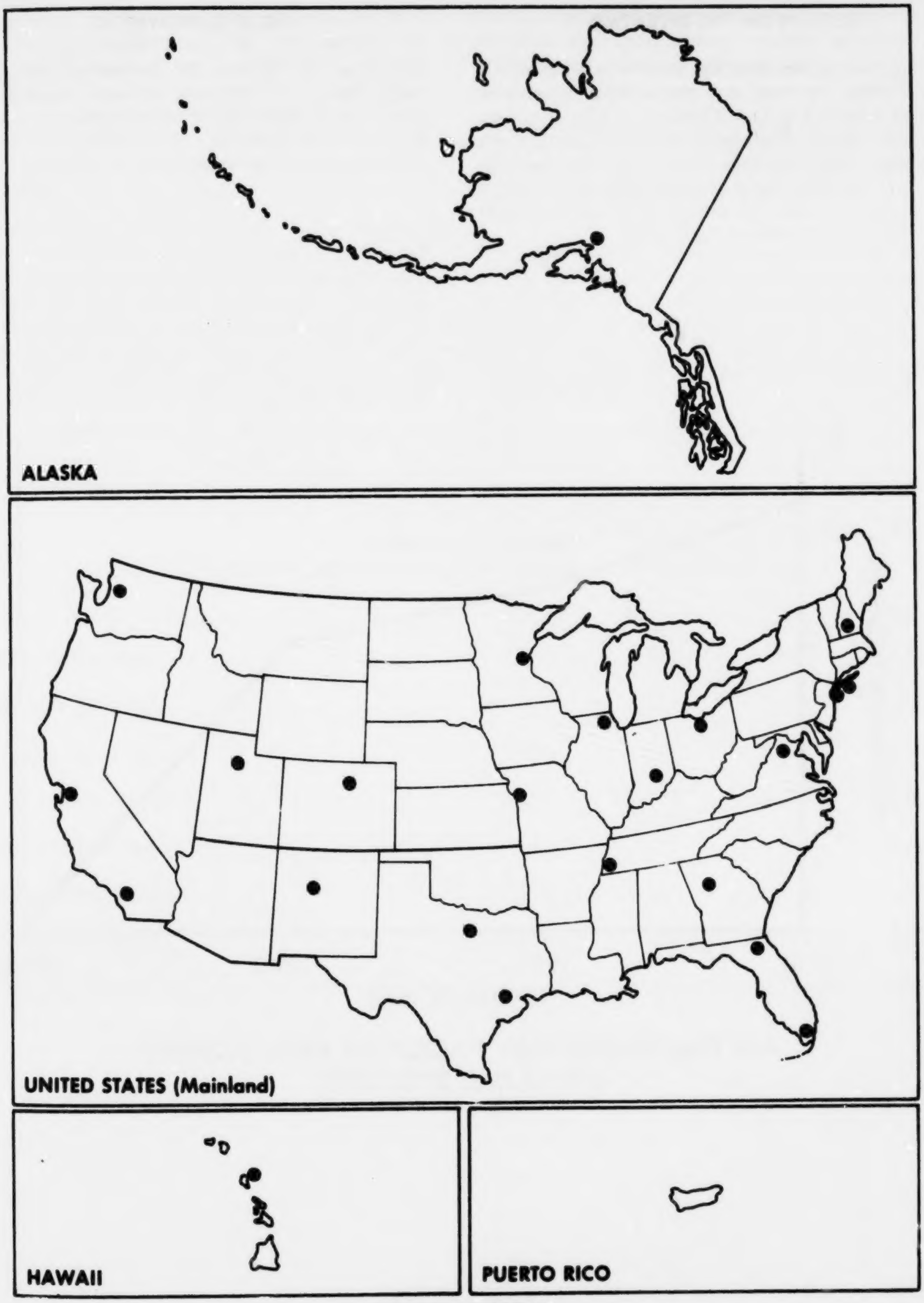
THIS MAP DEPICTS THE LOCATIONS OF AUTOMATION EQUIPMENT WHICH SUPPORT AIR TRAFFIC CONTROL OPERATIONS AT MAJOR AIRPORTS. SYSTEMS LOCATED ON OFFSHORE ISLANDS (E.G., GUAM) ARE NOT SHOWN.

● 89 - ARTS II/IIA LOCATIONS
■ 63 - ARTS III/IIIA LOCATIONS
▲ 35 - TPX 42/42R LOCATIONS


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1981-1990 SYSTEM
AUTOMATED TERMINAL RADAR AIR TRAFFIC CONTROL FACILITIES

TWENTY-ONE CONUS AREA CONTROL FACILITIES AND TWO OFFSHORE ACFs SUPPORT BOTH EN ROUTE AND TERMINAL FUNCTIONS. LOCATIONS MAY CHANGE AS PLANS CONTINUE TO DEVELOP.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

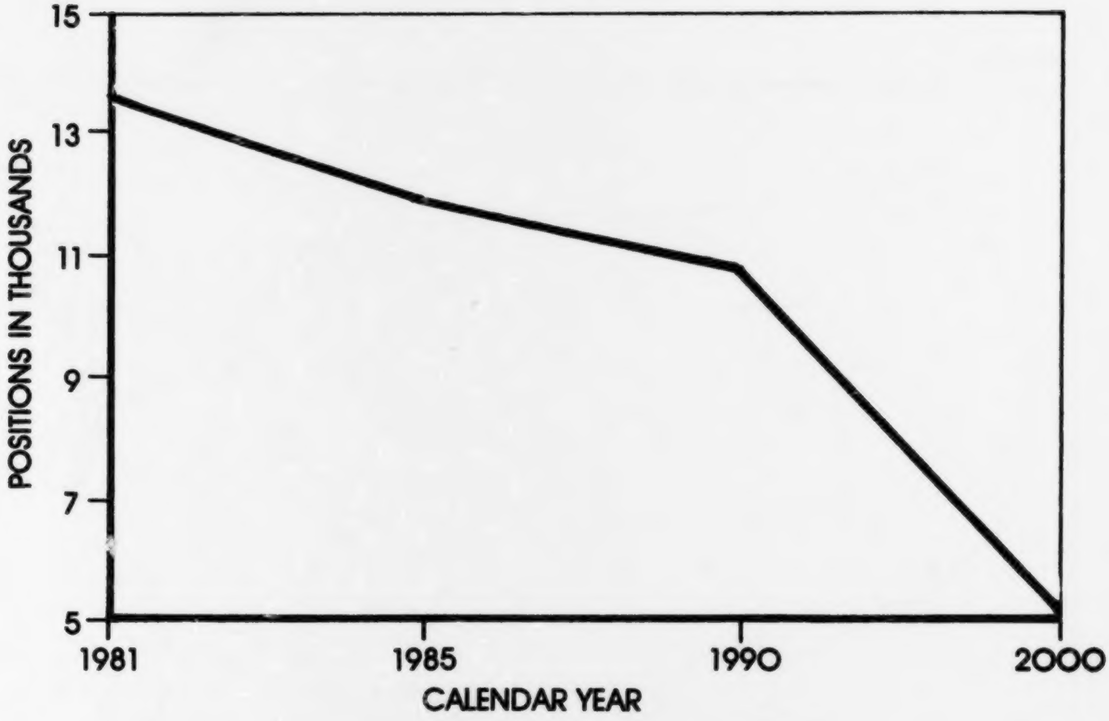
2000 SYSTEM
AREA CONTROL FACILITIES

RETURN ON THE INVESTMENT

During the next two decades, terminal services will be significantly improved and comparable capabilities will be provided to TRACONs and ATCTs in a cost-effective manner. The reliability with which services are provided will significantly improve. System capacity will be maximized by automated aids which reduce controller workload. Fuel efficiency will be maximized consistent with sustained flight safety.

FIELD EMPLOYMENT

During the next 20 years, the terminal system will undergo changes in hardware, software, and plant improvement. In particular, these changes will result in changes within both Air Traffic and Airway Facilities field employment as shown in the chart below.



AIR TRAFFIC/AIRWAY FACILITIES EMPLOYMENT (TERMINAL SYSTEMS)

The net effect will be a decrease in Airway Facilities personnel requirements at FAA field facilities by 56 percent and a decrease in current Air Traffic personnel requirements by 63 percent by the year 2000. However, this is partially offset by the increase in staffing described in the en route section. The total terminal and en route air traffic controllers staffing decreases by 36 percent.

In 1981, Airway Facilities and Air Traffic required 13,649 people to operate terminal facilities. By 1985, AF employment will decrease slightly. Solid-state conversion and the elimination of 33 low-level ATC towers result in a decrease in electronic and environmental equipment maintenance workloads, but is offset by establishment of additional towers and ARTS facilities. AT staffing requirements will be reduced to 9,200 positions due to these facility eliminations, the transfer of 35 nonradar approach control facility functions to ARTCCs, and terminal position review.

In 1990 employment will remain relatively constant due to the balance between demands of traffic growth and the productivity improvements brought about by automation improvements and establishments.

From 1990 to 2000, there will be considerable reductions in both AT and AF staffing due to the consolidation of TRACON operations into area control facilities and the resulting decommissioning of terminal automation and broadband radar display equipment. Total field staffing of 5,210 will operate and support 1,620 terminal facilities.

TERMINAL SYSTEMS
AIR TRAFFIC/AIRWAY FACILITIES EMPLOYMENT CHANGES

	1981	1985	1990	2000
Number of Facilities	1,422	1,762	1,896	1,620
Operations (millions)	61.6	61.4	83.4	105.6*
Air Traffic Personnel	11,800	10,202	9,200	4,400
AT Productivity Quotient	5,220	6,018	9,065	24,000
Airway Facilities Personnel	1,849	1,822	1,613	810
AF Productivity Quotient	33,315	33,699	51,705	130,370
Total AF & AT Staffing	13,649	12,024	10,813	5,210

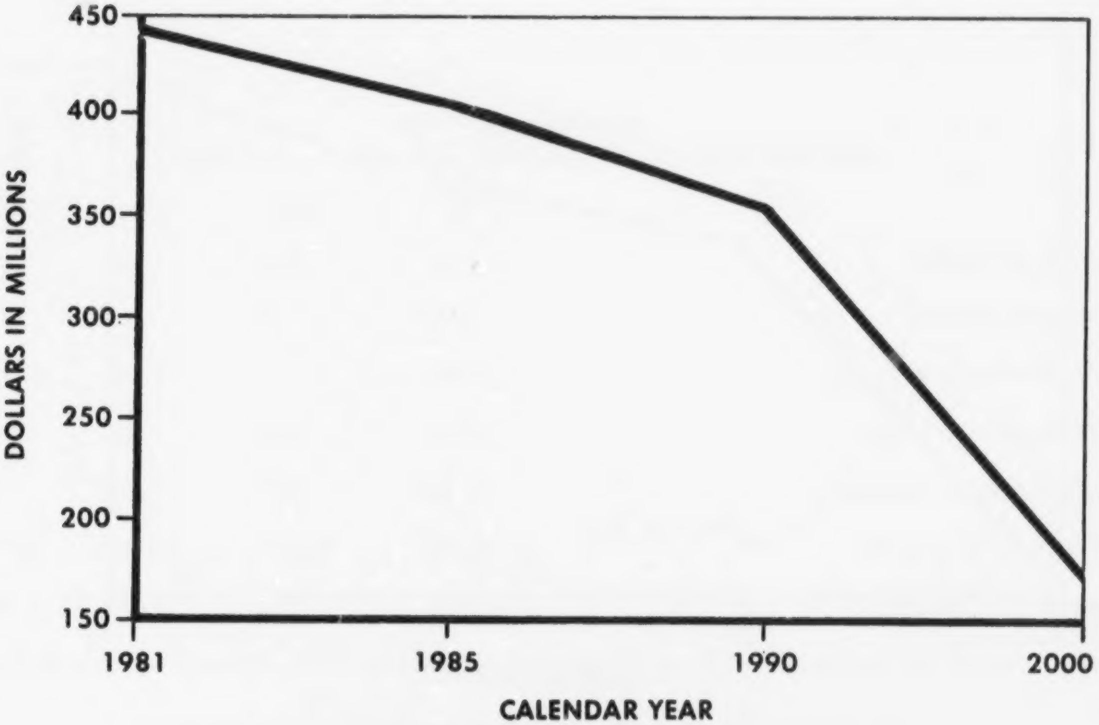
*Tower services only. Approach and departure control services will be performed by area control facilities.

FIELD OPERATIONS COSTS

Operating costs are a summation of estimated annual expenditures for field personnel, leased communications, rents and utilities, and other miscellaneous items. The costs for each of the years in this plan are a direct consequence of facility changes and their impact in these areas. Costs are in constant FY-81 dollars.

The Air Traffic personnel costs are based on the expected number of controllers and support personnel required at airport traffic control towers and terminal radar approach control facilities. The average salary cost for personnel for 1981, multiplied by the number of positions, is used to determine the total Air Traffic personnel costs for each of the years in this plan.

Airway Facilities personnel costs are derived by multiplying the total number of employee-years associated with the maintenance of equipment by the average salary of an electronics technician in 1981 ($34,100). The cost figure used here is based on the current demography of the AF work force and the expectation that trainee technicians and administrative positions will remain small compared to the overall field work force. These costs are summarized at the end of this section.



OPERATIONS COSTS

Estimated annual expenditures for renting teletypewriter equipment; land and buildings; local telephone service; electrical, gas, and water services; etc.; will decrease due to consolidation of facilities through the year 2000.

Expenditures for all other services such as storage of household goods, automotive maintenance and repair, aircraft rental, repair of technical building facilities and grounds, etc., will also drop significantly.

The table below summarizes annual operations costs in the terminal system.

TERMINAL SYSTEMS OPERATIONS COSTS (000)

	1981	1985	1990	2000
Air Traffic Personnel	351,640	304,020	274,160	131,120
Airway Facilities Personnel	63,051	62,130	55,003	27,621
*Leased Communications	10,000	18,000	10,000	1,000
Rents & Utilities	13,892	9,383	7,469	4,348
Other	6,936	11,773	10,422	5,234
Totals	445,519	405,306	357,054	169,323

*Costs shown are best estimates at the time of publication. Actual costs may differ due to negotiated tariffs.

Leased communications costs, shown above, include leased 301-type switching systems, modems, etc., in ATCTs and TRACONs and operations-funded local telephone services. Changes expected are:

1981-1985—Impact of AT&T divestiture will begin to be seen in higher lease and maintenance costs in 1984. No real competition is expected due to impracticality of replacing all leased systems with ICSS. New or relocated facilities, however, will be provided ICSS, initially leased, with FAA purchase options exercised where cost effective.

1985-1990—Leased communications costs will decrease as more facilities are equipped with FAA-owned ICSS and modem equipment.

1990-2000—Costs will reduce significantly early in this period, as nearly all leased equipment is replaced with FAA-owned ICSS/TCS equipment.

SUMMARY OF CHANGES

The general trend in terminal systems energy requirements over the next two decades will be a long-term decrease in cost and a marked decrease in consumption.

Decreased consumption during the near term (1981-1985) will be due to changeover of facilities from tube-type to solid-state and to the decommissioning of 33 small towers. From 1985 to 1990, the changeover of equipment from tube-type to solid-state devices will continue. By the year 2000, TRACON consolidation into ACFs will be completed.

TERMINAL SYSTEMS ENERGY DATA

	1981	1985	1990	2000
Energy (kWh × 10^6)	240	171	120	80
Costs (Millions)	12.0	8.6	6.0	4.0

SPECIFIC PROJECTS

The plan calls for 17 separate projects related to upgrading the terminal system, falling under three basic categories: automation, communications, and facility consolidation.

PROJECTS	IMPLEMENTATION	
	FIRST	LAST
ARTS III		
1. Provide Enhanced Terminal Conflict Alert	1984	1985
2. ARTS IIIA Assembler	1983	1984
3. Enhanced Target Generator (ETG) Displays (ARTS III)	1986	1987
4. Additional ARTS IIIA Memory	1985	1986
5. Additional ARTS IIIA Support System at the FAA Technical Center	1985	1985
ARTS II		
6. ARTS IIA Enhancements	1985	1987
7. Provide ARTS II Displays	1984	1985
8. ARTS II Interfacility Interface	1983	1985
9. ARTS II Interface with Mode S/ASR 9	1986	1988
COMMUNICATIONS		
10. Automatic Terminal Information Service (ATIS) Recorders	1986	1987
11. Multichannel Voice Recorders	1985	1988
12. Tower Communications System	1992	1995
FACILITY CONSOLIDATIONS		
13. ATCT/TRACON Establishment, Replacement, and Modernization	1981	2000
14. VFR ATCT Closures	1983	1986
15. Combine Radar Approach Control into ARTCC	1984	1987
OTHER		
16. Bright Radar Indicator Tower Equipment (BRITE)	1986	1988
17. TPX 42 Replacement	1986	1988

PROJECT SUMMARY

PROJECT 1: Provide Enhanced Terminal Conflict Alert

Purpose: The present conflict alert software has desensitized specific areas to reduce excessive nuisance alarms. This project develops, tests, and implements software modifications which resolve problems related to nuisance alarms without desensitizing areas.

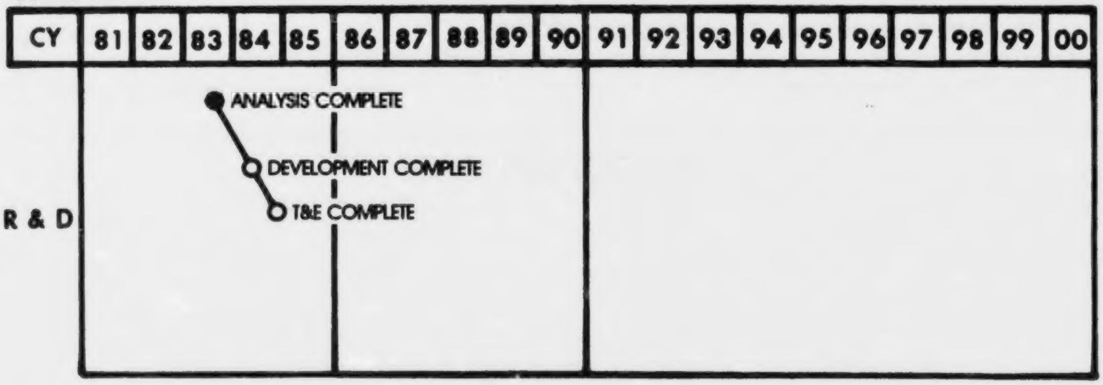
Reduction of nuisance alarms is required to maximize the effectiveness of the conflict alert function to the controller. Attainment of a minimal number of nuisance alarms requires optimum conflict detection in environments where larger numbers of aircraft are closely maneuvering, landing, and departing, and where simultaneous parallel approaches are regularly conducted.

Approach: Software enhancements will be procured to resolve problems in conflict alert. Outstanding issues that require research and resolution are: (1) refinement of conflict alert processing so as to optimize processor and memory resources, (2) refinement of conflict alert intersensor processing (a major contributor to excessive nuisance alarms), (3) analysis and resolution of radar errors due to registration and alignment inaccuracies, and (4) refinement of radar X-Y conversion.

Products: One software modification installed at 63 ARTS IIIA locations.

Related Projects/Activities: The addition of conflict alert to ARTS II is a program that is similar in function.

SCHEDULE



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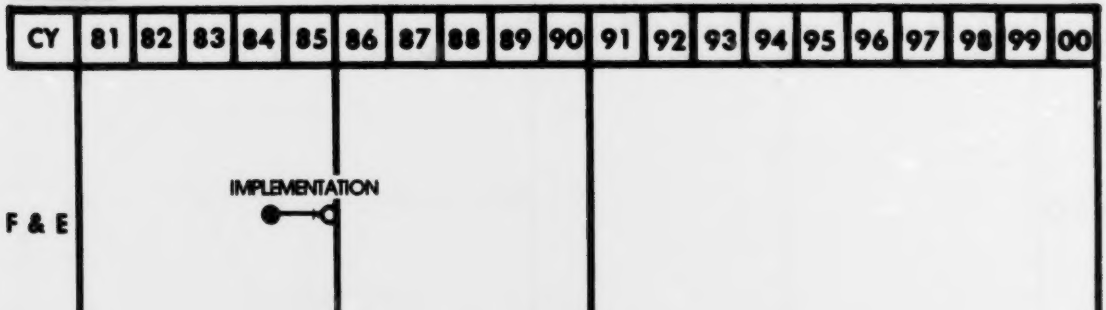
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IMPLEMENTATION

PROJECT 2: ARTS IIIA Assembler

Purpose: The present ARTS IIIA assembler is inefficient and difficult to use. This project will improve software maintenance by making the ARTS IIIA assembler more interactive and by establishing restart points in the assembly process.

Approach: Award a software contract to develop the necessary improvements. The improved assembler will require no more than two 16K memory modules.

Products: One software program to be installed at each qualifying facility.

Related Projects/Activities: None.

SCHEDULE

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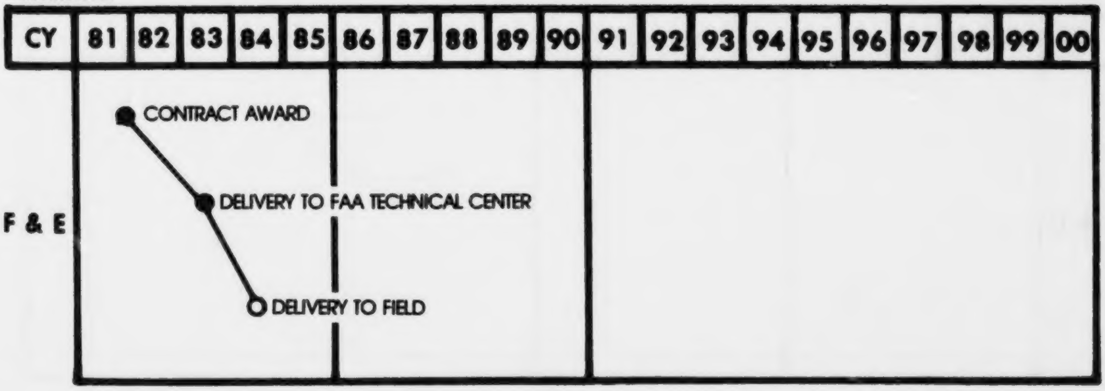
SCHEDULE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CONTRACT AWARD
DELIVERY TO FAA TECHNICAL CENTER
DELIVERY TO FIELD

PROJECT 3: Enhanced Target Generator (ETG) Displays (ARTS III)

Purpose: Currently, not all ARTS III facilities have the capability to perform onsite simulation training for controllers. This program provides sites with additional displays to be used as training displays. This is essential to enhance the air traffic controller onsite training requirements.

Approach: Displays will be provided along with additional communications as required.

Products: 50 displays.

Related Projects/Activities: None.

SCHEDULE

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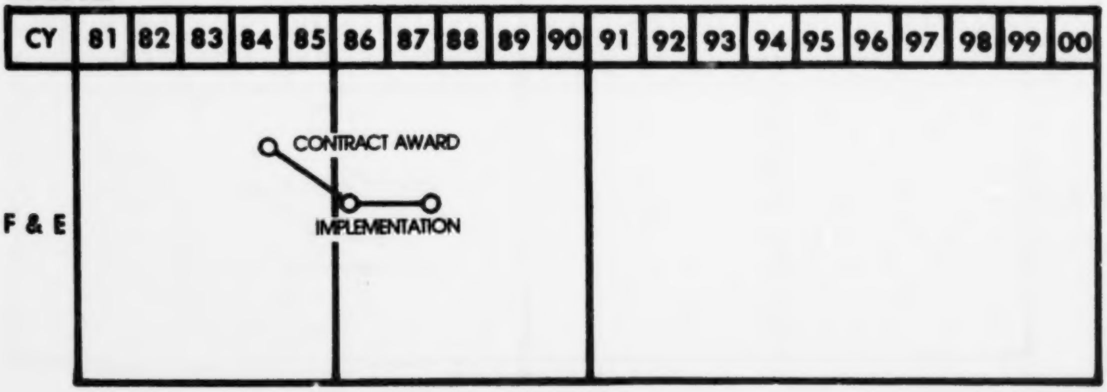
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IMPLEMENTATION

PROJECT 4: Additional ARTS IIIA Memory

Purpose: The ARTS IIIA operational program utilizes all available memory which exists onsite. Additional memory must be procured to sustain traffic growth until the systems are replaced by the advanced automation system. System capacity must be increased to accommodate traffic growth.

Approach: Procure an additional 32K memory for each ARTS IIIA site.

Products: Memory hardware for 63 locations.

Related Projects/Activities: Advanced automation system will, in the long term, replace ARTSs.

SCHEDULE

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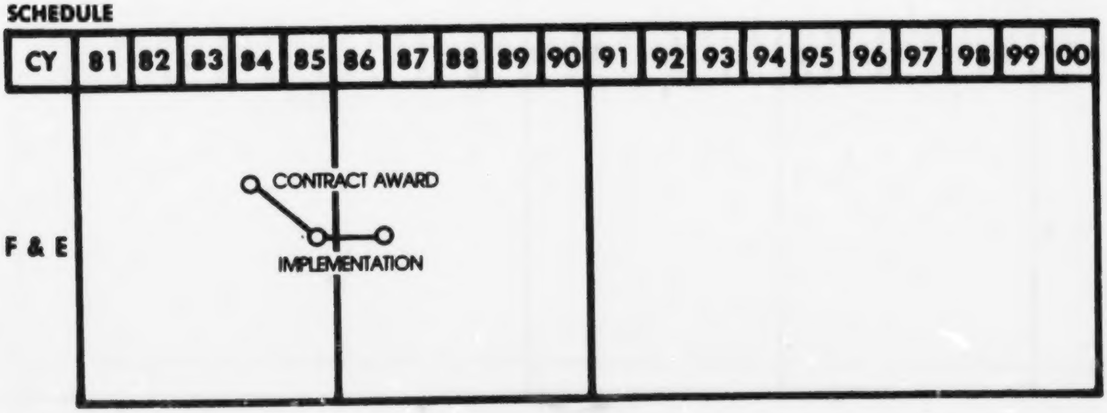
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IMPLEMENTATION

PROJECT 5: Additional ARTS IIIA Support System at the FAA Technical Center

Purpose: The present terminal system support facility (TSSF) at the FAA Technical Center consists of a single ARTS IIIA with an 8-processor and l5-memory module configuration which is used to support the New York TRACON, EARTS, and ARTS IIIA. The TSSF is used by both FAA and contractor personnel to develop hardware and software enhancements. The TSSF supports many diverse operational functions: diagnostic software maintenance, new software development, hardware modification development, failure or other problem recreation, and system interfacing. Several of these activities conflict with each other (i.e., hardware modifications versus new software development). The necessity for the system to support distinct configurations of equipment has resulted in a complex configuration switching system which is difficult to use and has reduced the overall system availability. Further, the demand for utilization of the existing hardware by FAA and contractor personnel currently exceeds available hours. This demand is expected to continue over the next 4 to 5 years. A second system is needed to satisfy the demand.

Approach: Procure a stand-alone ARTS IIIA for the TSSF.

Products: One dual system for the FAA Technical Center.

Related Projects/Activities: Software modifications of ARTS IIIA. Test and evaluation of host computers.

SCHEDULE

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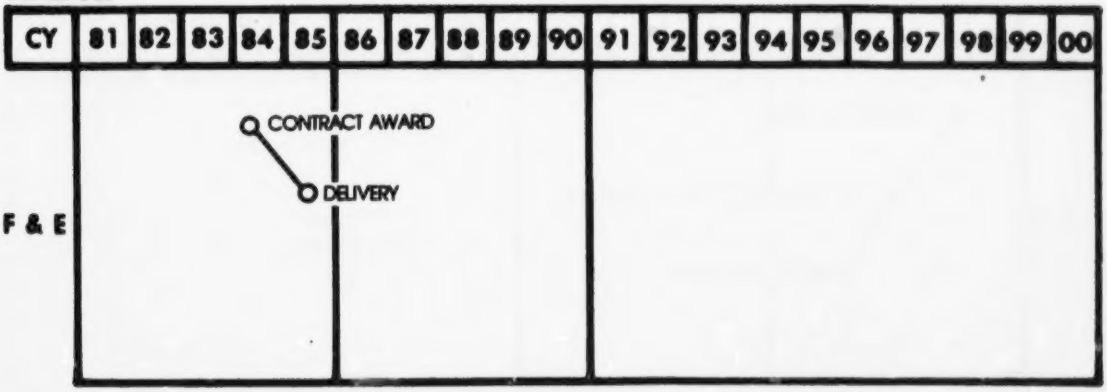
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DELIVERY

PROJECT 6: ARTS IIA Enhancements

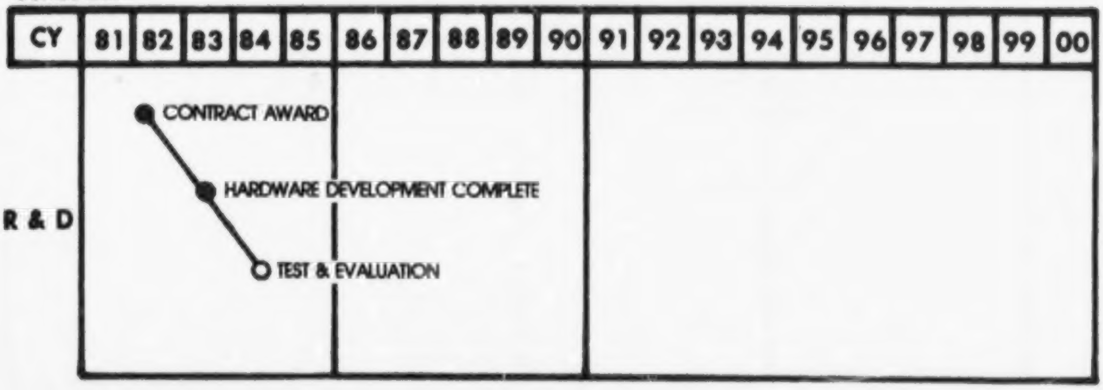
Purpose: This project will enhance ARTS II to add beacon tracking, MSAW, conflict alert, and a training target generator. Conflict alert and MSAW are required to alert controllers to potential hazardous conditions when less than standard separation exists. The training target generator provides the capability to train controllers in selected and varied control situations in a simulated environment.

Approach: Procure equipment, software, and services to provide conflict alert, minimum safe altitude warning (including cartographic support for terrain description), training target generator, and tracking for ARTS II. Software will be developed using techniques and methods currently in use in the ARTS II and ARTS IIIA systems.

Products: 89 operational locations plus six support systems.

Related Projects/Activities: Development results from ARTS IIIA conflict alert enhancements will be considered in the design of ARTS IIA conflict alert.

SCHEDULE



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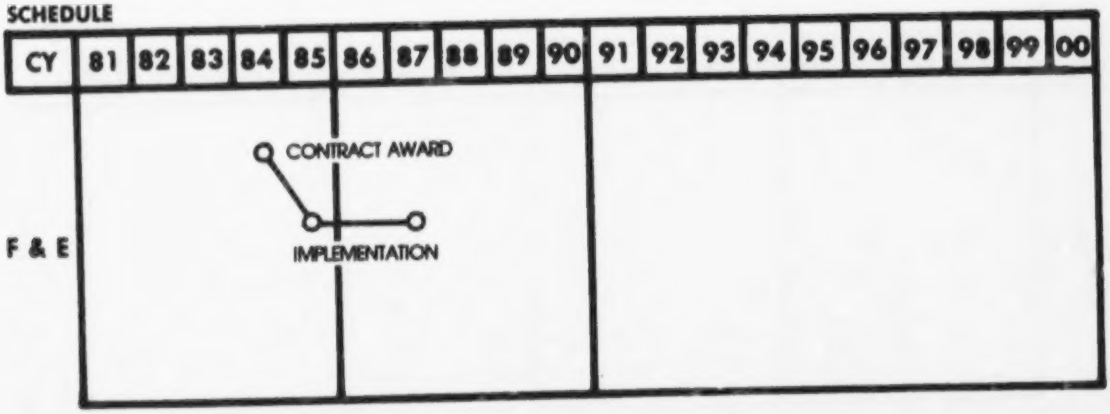
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IMPLEMENTATION

PROJECT 7: Provide ARTS II Displays

Purpose: Several ARTS II facilities were commissioned using BRITE-type displays in a TRACON configuration. The control room was designed to allow installation of ARTS II radar displays. This project will provide these displays.

Approach: Provide ARTS II radar display.

Products: ARTS II radar alphanumeric display subsystems will be provided for eight locations.

Related Projects/Activities: None.

SCHEDULE

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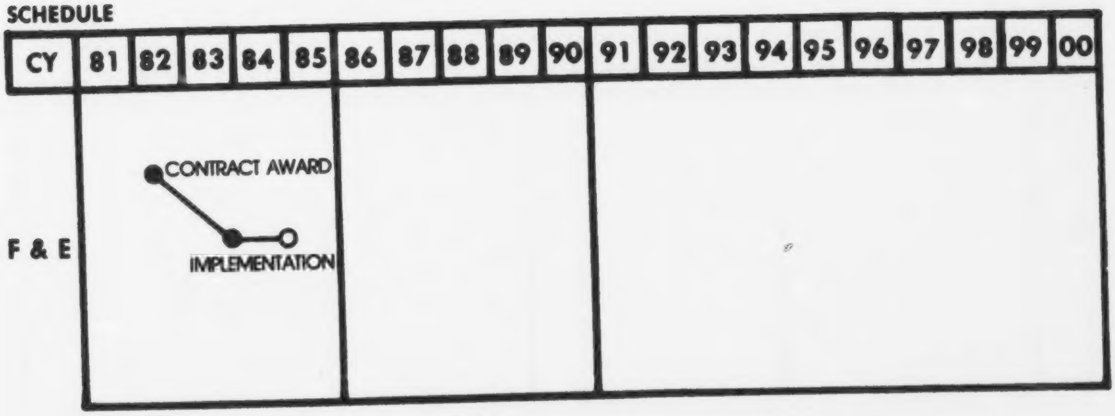
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IMPLEMENTATION

PROJECT 8: ARTS II Interfacility Interface

Purpose: Initially, only 32 of the ARTS II systems were provided with interfacility interface capability to associated ARTCCs. This capability is needed for most remaining ARTS II systems. The interfaces will increase controller productivity by reducing controller workload. This project provides the equipment at these terminals and associated ARTCCs to meet this requirement.

Approach: In order to provide an automated ability for handoff and transfer of flight data, the terminal facilities must be provided with modems, memory, and associated equipment; and the ARTCCs must be provided with modems and computer adapters.

Products: Interface hardware for 51 terminal and 20 ARTCC locations.

Related Projects/Activities: Replacement of flight data entry and printout (FDEP) devices with flight data input/output (FDIO) equipment. The FDIO program will make available input/output adapter ports in ARTCCs to allow the implementation of this ARTS II Interface.

SCHEDULE

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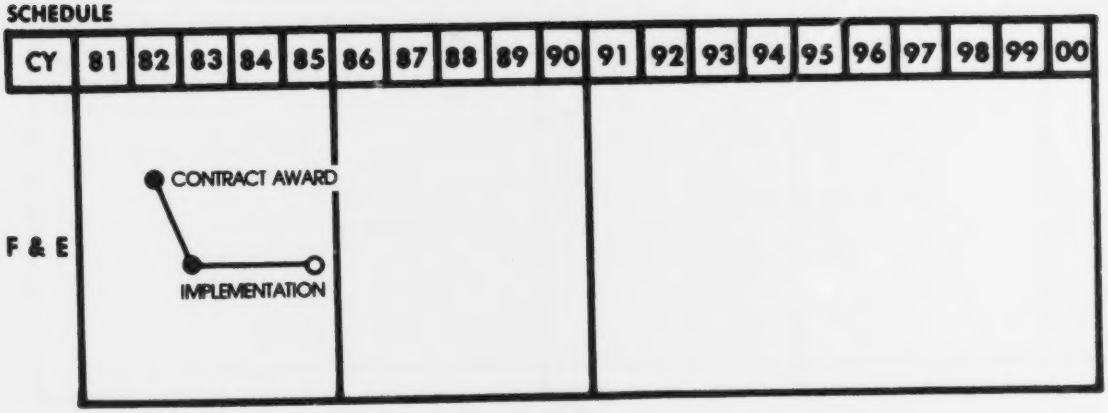
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IMPLEMENTATION

PROJECT 9: ARTS II Interface with Mode S/ASR 9

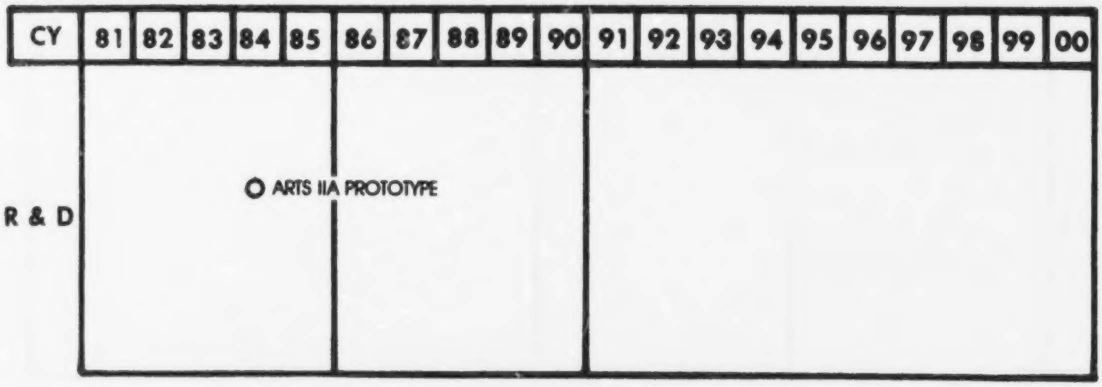
Purpose: This project will develop the hardware and software that will allow the ARTS IIA to receive and process digital surveillance data from terminal radar sites. This interface will allow for transmission of common digitizer (CD) formatted radar and ATCRBS-type messages, but will not include messages associated with discrete addressing, data link, or Mode S communications.

Approach: Develop, test, and evaluate hardware and software modifications to the ARTS IIA so that CD-type messages can be reformatted into data usable by the ARTS. The ASR 9 (airport surveillance radar) has a digital CD format output as does the Mode S. To be compatible, the ASR 7 and 8 radar analog output will have to be digitized into CD format.

Products: One interface modification package for each ARTS IIA site.

Related Projects/Activities: Mode S/Data Link project is related through schedule dependency. Terminal radar (ASR) program provides ASR 9 radars and digitizing for ASR 7 and 8 radars.

SCHEDULE



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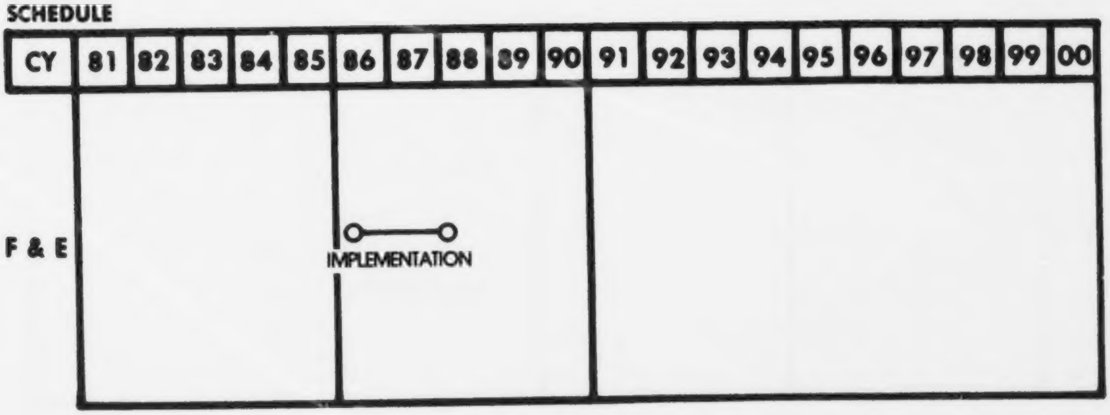
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IMPLEMENTATION

PROJECT 10: Automatic Terminal Information Service (ATIS) Recorders

Purpose: ATIS recorders are used to transmit weather and airport conditions to pilots in controlled terminal areas. Existing ATIS recorder types are electromechanical with operational reliability problems. Solid-state ATIS recorders are cost beneficial because of maintenance and space advantages. Approximately 10 percent of the obsolete recorders have already been replaced with minimal maintenance solid-state models. Such highly reliable solid-state units are needed at all facilities.

Approach: Solid-state ATIS recorders will be procured off the shelf for deployment in the 1986-1988 time frame.

Products: A total of 600 units (200/year) will be procured over a 3-year period beginning in 1985. Approximately 450 of these will replace existing TRC-89's, and 150 are designated for new locations.

Related Projects/Activities: Future interface to automatic weather observation system (AWOS).

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
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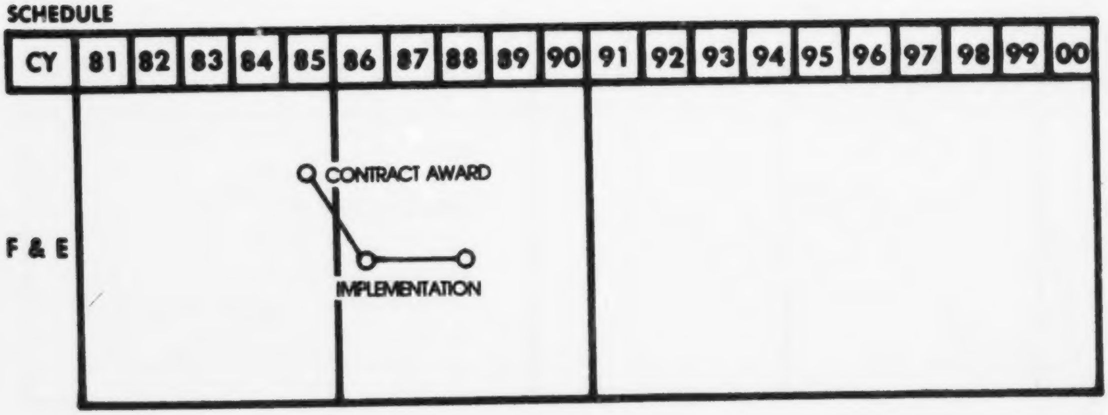
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CONTRACT AWARD
IMPLEMENTATION

PROJECT 11: Multichannel Voice Recorders

Purpose: Multichannel voice recorders are utilized to record all voice communications between air traffic controllers and pilots. The existing 5- and 9-channel recorders are electromechanical with operational reliability problems. In addition, the 152-channel recorders located at ARTCCs can no longer be reliably supported to meet long-term needs. High-capacity, solid-state recorders are cost beneficial because of maintenance and space advantages. Approximately 60 percent of the obsolete recorders have already been replaced with minimal maintenance solid-state models of 10 and 20 channels.

Approach: Provide modularly expandable recorders for ARTCC operations. Replacement of 5- and 9-channel recorders with 10- and 20-channel recorders will continue at FSS and ATCT locations.

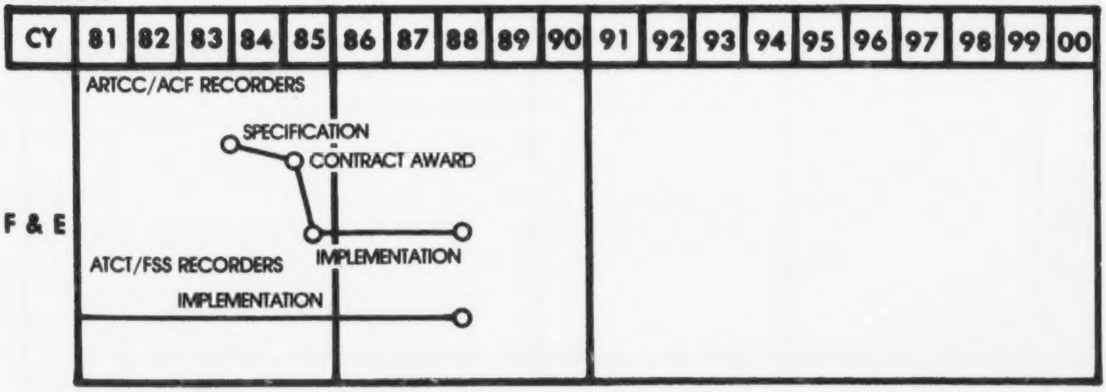
Products: A total of 360 recorders will be procured: 329 10- and 20-channel units for ATCTs, FSSs, and support facilities and 31 of the modularly expandable units for ARTCCs, New York TRACON, and support requirements. Use will continue after ACF implementation.

Related Projects/Activities: ACF establishment, automated flight service station, VSCS, ICSS, TCS.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

SCHEDULE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ARTCC/ACF RECORDERS
SPECIFICATION
CONTRACT AWARD
IMPLEMENTATION
ATCT/FSS RECORDERS
IMPLEMENTATION

PROJECT 12: Tower Communications System

Purpose: This project will develop a modern voice communications switch and control system which meets the needs of future tower operations. Replacement of the present system with modern equipment will significantly improve the maintenance aspect of the tower equipment.

Approach: The implementation of advanced tower suites will require new communications control capabilities incorporating features of the much larger VSCSs in the area control facilities. Two concepts will be evaluated:

- Replace the control heads of the type-1 ICSS equipment to emulate the ergonomic design and functions of VSCS. This approach will require additional procurement of compatible hardware at all towers with tower suites.

- Develop and implement replacements for all existing voice control systems, utilizing VSCS-type technology and human interfaces.

The tower communications system (TCS) will be procured for implementation in the tower suite position console installed by the advanced automation contract. The development of the system concept and specification for TCS will be initiated in FY-85 and FY-87, respectively. This will support issuing a request for proposal (RFP) in FY-89 and a production contract in FY-90. This contract will be for existing off-the-shelf equipment, modified if necessary to meet specific requirements. The first unit delivery will be in FY- 92 to correspond to the delivery of the tower suites.

Products: Depending upon the approach chosen, between 250 and 410 systems are estimated, including those in the 1990's where, because of consolidation, it may be cost-effective to replace ICSSs installed over 10 years. If replacement is necessary, ICSSs will not be ordered for towers after 1990.

Related Projects/Activities: ICSS, radio control equipment, VSCS, and Advanced Automation System. This project appeared in the 1983 edition in Chapter V, Interfacility Communications Systems.

SCHEDULE

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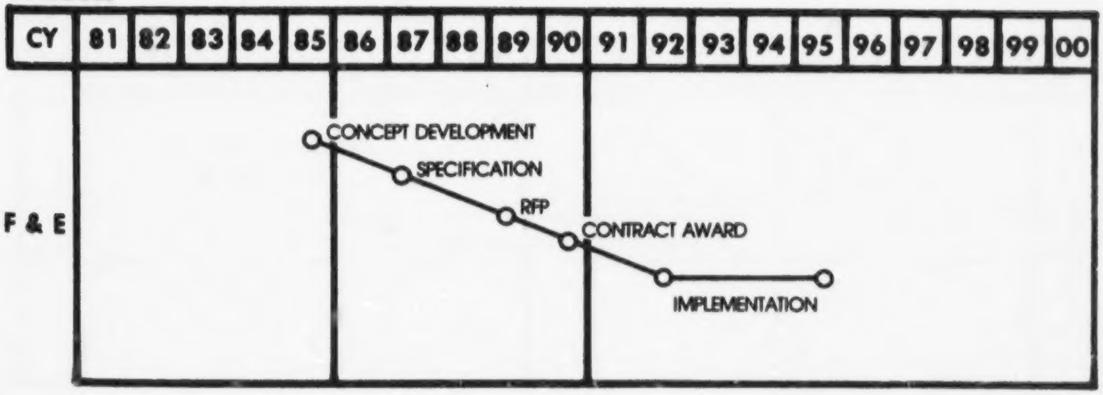
R & D																				

SCHEDULE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CONCEPT DEVELOPMENT
SPECIFICATION
RFP
CONTRACT AWARD
IMPLEMENTATION

PROJECT 13: ATCT/TRACON Establishment, Replacement, and Modernization

Purpose: This project provides for establishment of terminal ATC facilities (towers) and takeovers of sponsor-owned towers that meet airway planning standards, criteria, and modernization or replacement when necessary. It also includes modernization of existing towers to add operating positions; establish training space; upgrade TRACABs to TRACONs; replace obsolete or unreliable engine generators and heating, ventilating, and air conditioning (HVAC) systems; and to accommodate the Maintenance Program for the 1980's.

A number of existing facilities will surpass their 20 years' design life prior to the year 2000. Thus, major costs will be incurred to replace or upgrade environmental systems and rehabilitate operational and administrative spaces.

Approach: FAA headquarters develops national standards and makes national environmental support buys. Construction will be by regional contracts supported by national architectural engineers for site-specific designs. This project will not include TRACONs after 1984 due to the area control facility (ACF) program. Thirteen air carrier and commuter locations are under consideration for the establishment of towers requiring a newly constructed facility or for assumption of existing sponsor-owned facilities.

Products: Twenty-four facilities have been identified, with five additional sites to be named, for relocation/replacement within the next 3 years (through 1985)—a total of 29. It is estimated there will be three per year from 1986 through 2000. Approximately 226 facilities will receive some level of modernization through 1984. In 1983, 15 sites were in various stages of completion. Fifty-six additional sites are programmed for 1984. The remaining 155 are categorized as minor; i.e., wind instruments, clocks, digital altimeter setting indicators, etc. Thirteen additional sites are under consideration for either tower establishments or the assumption of an existing facility.

Related Projects/Activities: Area control facilities, tower suites, ICSS, TCS and the combining of approach control functions into ARTCC facilities.

SCHEDULE

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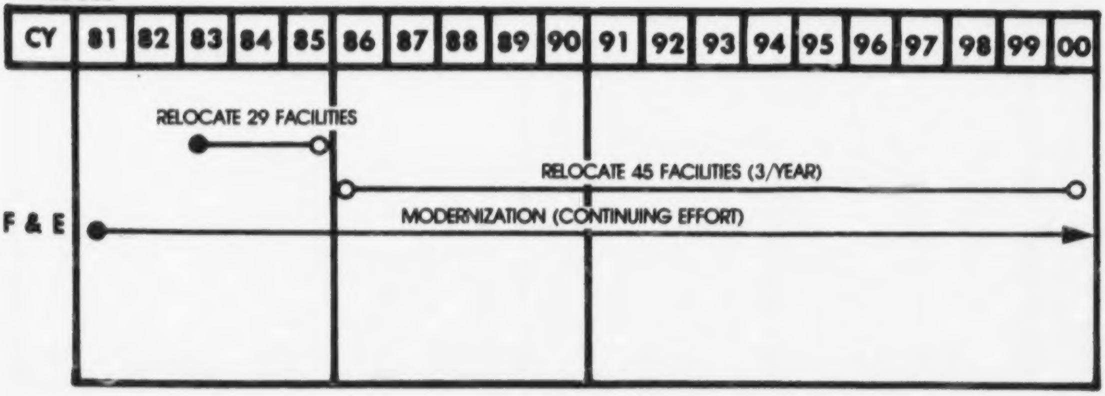
SCHEDULE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RELOCATE 29 FACILITIES
RELOCATE 45 FACILITIES (3/YEAR)
MODERNIZATION (CONTINUING EFFORT)
F & E

PROJECT 14: VFR ATCT Closures

Purpose: This project will improve cost-effectiveness and operational productivity of the federally operated ATC system. Over 200 Air Traffic positions would become available for use at other locations.

Approach: Subject to final approval, towers that do not meet existing retention criteria will be closed. Local governments will be given the opportunity to assume responsibility for operation of closed towers. Modular tower structures that are not operated by local governments will be mothballed and available for use at a later date or possibly for use at another location. FAA may share leased-line costs for interconnection of facilities if operated by other operators.

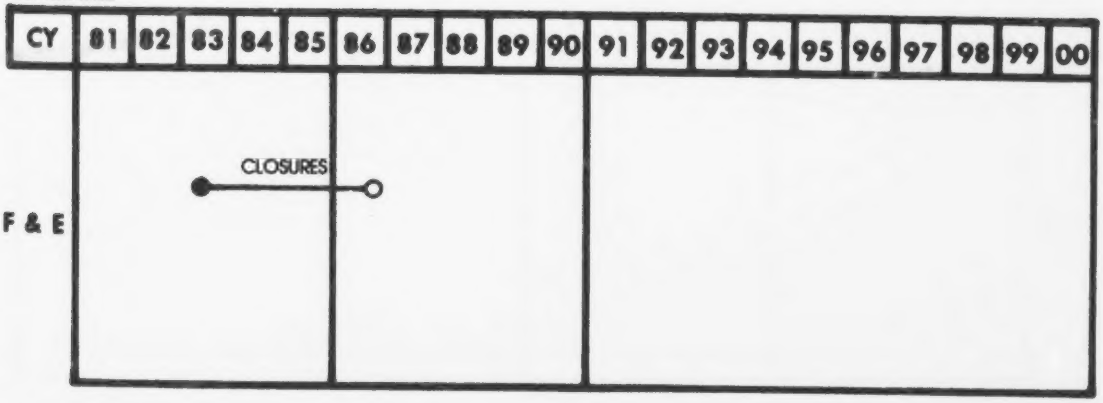
Products: Thirty-two towers have been proposed for closure in FY-84. Approximately 20 more are being considered for closing by FY-87.

Related Projects/Activities: None.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

SCHEDULE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F & E
CLOSURES

PROJECT 15: Combine Radar Approach Control into ARTCC

Purpose: Consolidating selected TRACONs into adjacent ARTCC buildings will result in a more cost-effective operation as resources are utilized in a more efficient manner. The TRACONs affected by this project would have required substantial modernization or even complete replacement within 10 years. By consolidating now, these very costly efforts will be avoided. An overall reduction in building maintenance and operations costs will also be realized.

Approach: Relocate each affected TRACON operation, including the ARTS computer, displays, radar, radio, and flight data equipment, to the nearest ARTCC building. Establish radar and communications links between the existing radar/communication sites and the ARTCC. Construct an enclosure in the operation wing to accommodate this function which will not interfere with the transition of the ARTCC to an ACF configuration. Establish microwave links to provide radar information to the ATCTs. The combined facilities will function until the advanced automation system allows for a totally integrated terminal/en route area control facilities.

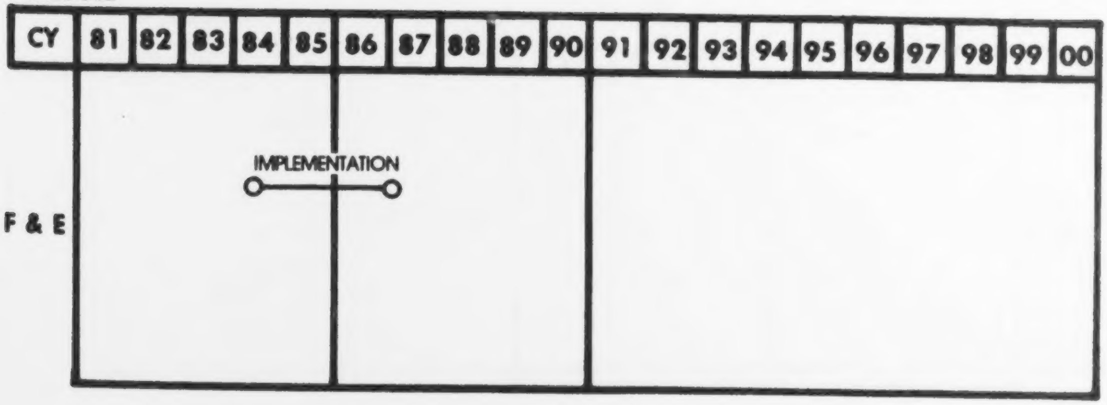
Products: Seven TRACONs are currently being considered for this relocation/combination project. Four CONUS ARTCCs, plus one EARTS facility, will be accommodating these seven TRACONs.

Related Projects/Activities: This project is related to the area control facility (ACF) and advanced automation programs (AAP) because, as these new programs are implemented, the requirement for a co-located TRACON will be eliminated. In the interim period prior to AAP, several terminal and en route projects will be effected. The FDIO equipment requirement will be limited to flight strip printers. Additional RML and TML equipment may be required. Center modernization projects will have to consider ARTS requirements.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

SCHEDULE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F & E
IMPLEMENTATION

PROJECT 16: Bright Radar Indicator Tower Equipment (BRITE)

Purpose: This project will replace the BRITE systems which have been in the field since 1967 and do not provide reliable service. It will also provide display systems for satellite airport traffic control towers (ATCT) that presently do not have radar information available.

Approach: Procure BRITE systems which take advantage of digital scan converter technology. Digital scan converter systems are inherently much more stable and reliable than the plan position indicator (ppi)/TV camera converters in use today. Approximately 60-70 percent maintenance workload reductions will result. This project will replace BRITE I, BRITE II, and BRITE IV with the new system. The new system will also be installed at qualifying satellite towers. This project is a joint FAA/DOD procurement with the USAF as the procuring agency.

Products:

- 50 systems for satellite ATCT.
- 350 systems at 189 locations to replace BRITE I, II, and IV.

Related Projects/Activities: Satellite ATCT BRITE establishment requires the acquisition of TML.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
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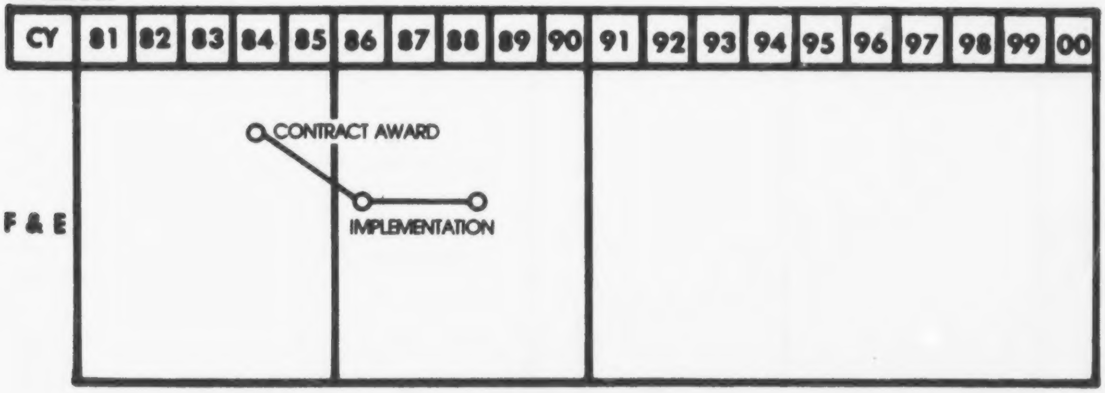
SCHEDULE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CONTRACT AWARD
IMPLEMENTATION
F & E

PROJECT 17: TPX 42 Replacement

Purpose: The TPX 42 systems were installed around 1972. The current TPX 42 does not provide ATC features that are necessary in today's environment (i.e., alphanumerics, tracking, conflict alert, test target generator, and interfacility interface). This program replaces TPX 42's and ensures service until the area control facilities are established.

The replacement system must provide those standard services and allow for expected growth in traffic.

Approach: Procure 35 ARTS IIA-type systems, including displays. Displays procured for the TRACON environment will be plan position indicators (ppi) and BRITE for TRACABs. BRITE systems will be procured as additions to the BRITE replacement contract.

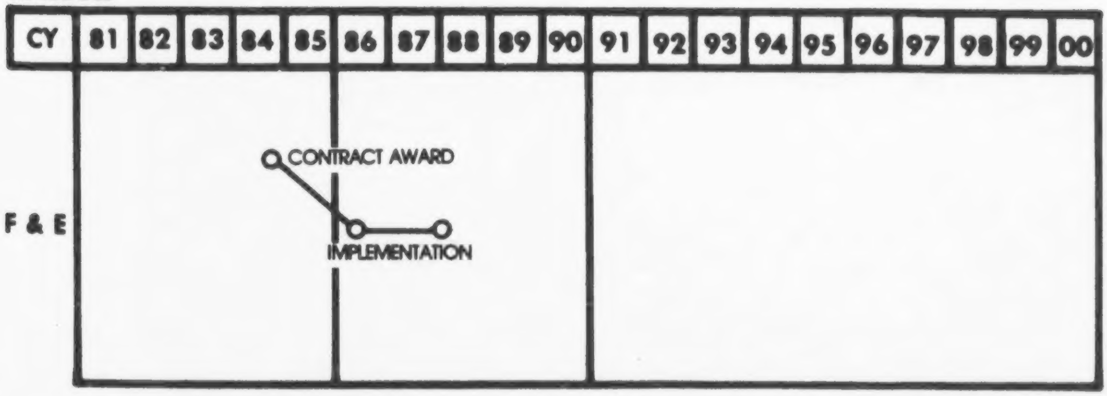
Products: Thirty-five TPX 42 replacement systems (34 operational, 1 support).

Related Projects/Activities: ARTS IIA, Mode S ARTS II interfacility interface, BRITE replacement program. Implementation of new FDIO equipment will make available input/output adapter ports in the ARTCC to allow for the interfacility interface.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

SCHEDULE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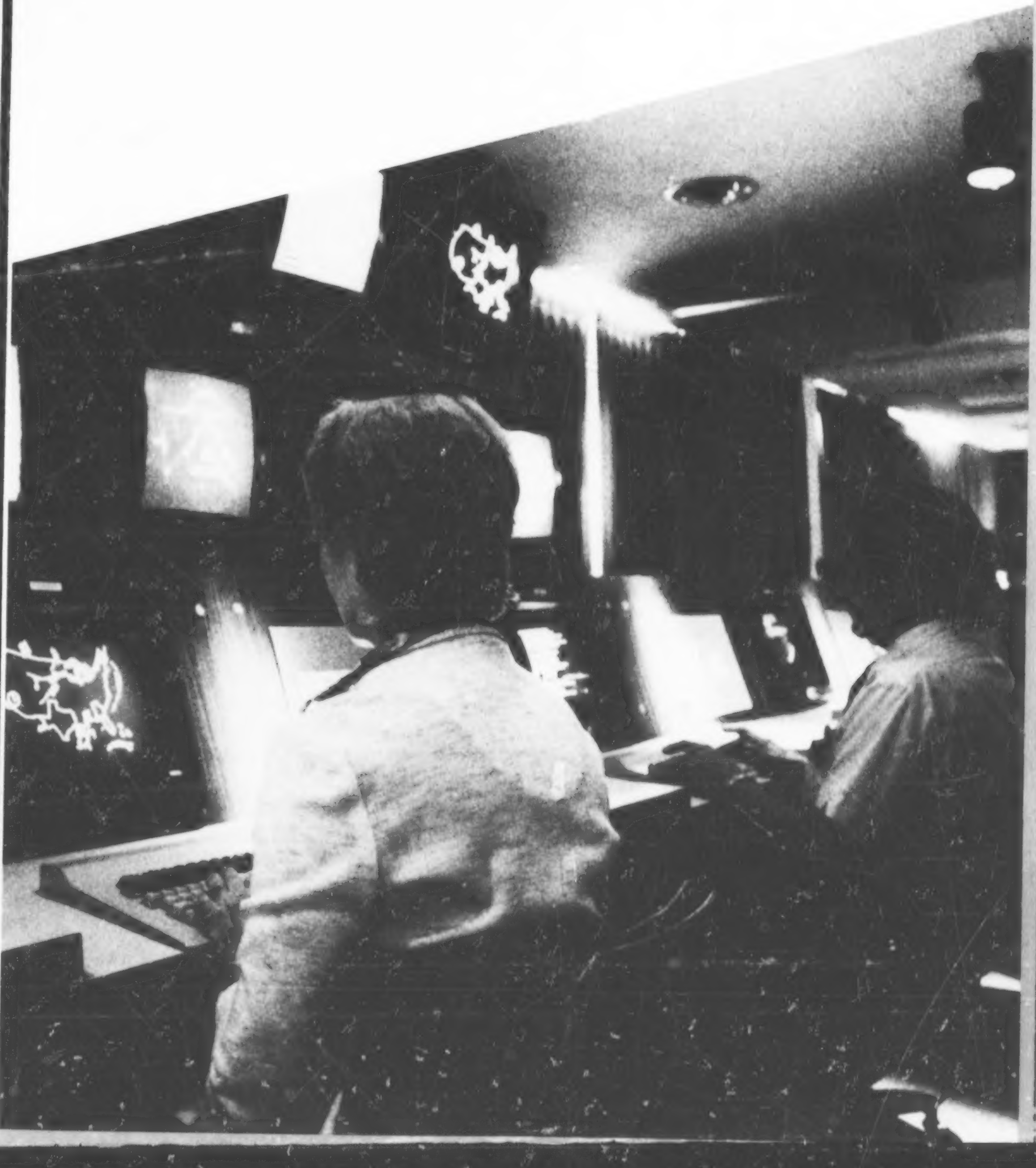
CONTRACT AWARD
F & E
IMPLEMENTATION

FLIGHT SERVICE



FLIGHT SERVICE SYSTEMS

There are more than 300 FAA flight service stations (FSS) offering a broad range of preflight and in-flight services especially aimed at general aviation (or non-airline pilots). Theses services include:

- Accepting and closing flight plans.
- Conducting preflight weather briefings.
- En route communications with pilots flying under visual flight rules.
- Assisting pilots in distress.
- Disseminating aviation weather information.
- Monitoring radio navigation stations.
- Originating notices to airmen.
- Working with search and rescue units in locating missing aircraft.

At certain locations, flight service stations take weather observations, issue airport advisories, provide en route flight advisory service, and advise customs and immigration officials of transborder flights. The stations also have communications equipment for relaying information to towers and air traffic control centers and for various emergency services.

Flight service stations range in size from very small facilities to large ones employing approximately 100 people. The buildings housing the stations vary in size, design, and age.

Of all the FSS services, none is more important to safety than that related to weather. The FAA aviation weather system collects weather information and distributes it to both pilots and agency operations personnel. Weather information is collected largely with electromechanical devices that give wind direction, velocity, temperature, dew point, ceiling, visibility, and altimeter settings. Facsimile weather maps and low-speed teletypewriters also are used.

FAA long-range surveillance radars are also used to give two levels of contours to outline weather on en route radar displays for controllers and for center weather service unit (CWSU) meteorologists at the en route centers. Other aviation weather information comes from the National Weather Service; Aeronautical Radio, Inc. (ARINC); pilot reports; and observations made by agency personnel.

To get weather information to pilots, the agency depends on telephones and radio voice broadcasts, including advisories made over VOR radio stations used for navigation. At some locations, voice recordings disseminate mass weather information. For preflight briefings and in-flight advisories, direct communications between the pilot and flight service station specialist are used.

THE NEW APPROACH

Flight services will be improved for pilots by giving them direct access to weather information and flight delay information, both in the air and on the ground, and simplifying flight plan filing. Aviation weather service will be improved in quality and timeliness, thus, improving safety and saving fuel.

Automation and improvement of flight service stations and related aviation weather systems will allow consolidation of facilities, reducing operating costs significantly. Automation of weather radar and current weather information will provide more usable and current information to en route and terminal controllers.

HOW THE SYSTEM WILL EVOLVE

Procurement of new computer systems for the automation of flight service stations is already underway.

NEAR TERM (TO 1985)

FSS specialists will be provided with more timely national weather data at their consoles. Automation will greatly accelerate retrieval of weather information and the entry of flight plans.

Also during the near term, limited direct access for pilots will be provided by an interim computer-generated voice response system. This will permit pilots to retrieve information from an automated weather data base via telephone. Replacement of low-speed teletypewriters with data terminal equipment will also begin. Development of improved weather sensors and products will continue.

Automated weather sensors at selected airports will be tested and provide current airport weather information directly to pilots. Prerecorded significant weather advisories will be broadcast over selected VORs. Satellite weather photos will be available at certain locations over facsimile recorders, displaying the location cloud cover and weather systems.

Low-level wind shear equipment will be added at more airports to detect hazardous wind conditions. Six levels of weather radar contouring, outlining storms, will be on television displays for en route meteorologists and the specialists at flight service stations.

INTERMEDIATE TERM (TO 1990)

Major improvements to flight service automation will allow direct pilot access to weather and system delay information by telephone or through remote terminals. Flight movement data processing will be improved. Computer-aided direction finder triangulation will expedite locating and assisting lost aircraft. High altitude en route flight advisory service (EFAS), which provides a clear communications channel above 18,000 feet for pilot reports and en route weather, will be implemented. The modernized system of 61 automated flight service stations will be completed, and all nonautomated flight service stations will be consolidated into automated flight service stations with greater capabilities.

New communications switching systems will allow for automatic call distribution, telephone answering, and the recording of flight plans which improve pilot access and expedite coordination with flight service specialists. The replacement of low-speed teletypewriter equipment will be completed.

Using Mode S/data link, automated weather information will be available to pilots flying above 12,500 feet mean sea level and at qualifyng airports. Request/reply weather service will be available as will significant meteorological reports from center meteorologists.

VOR radio navigation stations will provide routine weather broadcasts and hazardous weather advisories. Computer-generated voice weather information will be broadcast continuously over the national VOR network. These broadcasts will be available to aircraft flying at or higher than 2,000 feet above the terrain. These automated weather broadcasts will give current weather and significant meteorological reports to the large number of general aviation and rotorcraft pilots who fly at the lower altitudes. Voice output derived from automated weather sensors will be broadcast over VOR stations to provide airport surface weather information. Flight service station voice communications with pilots will continue to take place over other local and remote communications outlets.

Additional automated weather sensors will be installed at airports.

Implementation of Doppler weather radar and improvements in radar weather information derived from FAA terminal surveillance radars will provide more accurate and timely weather radar.

The central weather processors at air route traffic control centers will begin to distribute current weather radar information to controllers, flight service specialists, and center weather service unit meteorologists. In addition, the central weather processor will provide automated distribution of alphanumeric and graphic weather information to controllers and meteorologists.

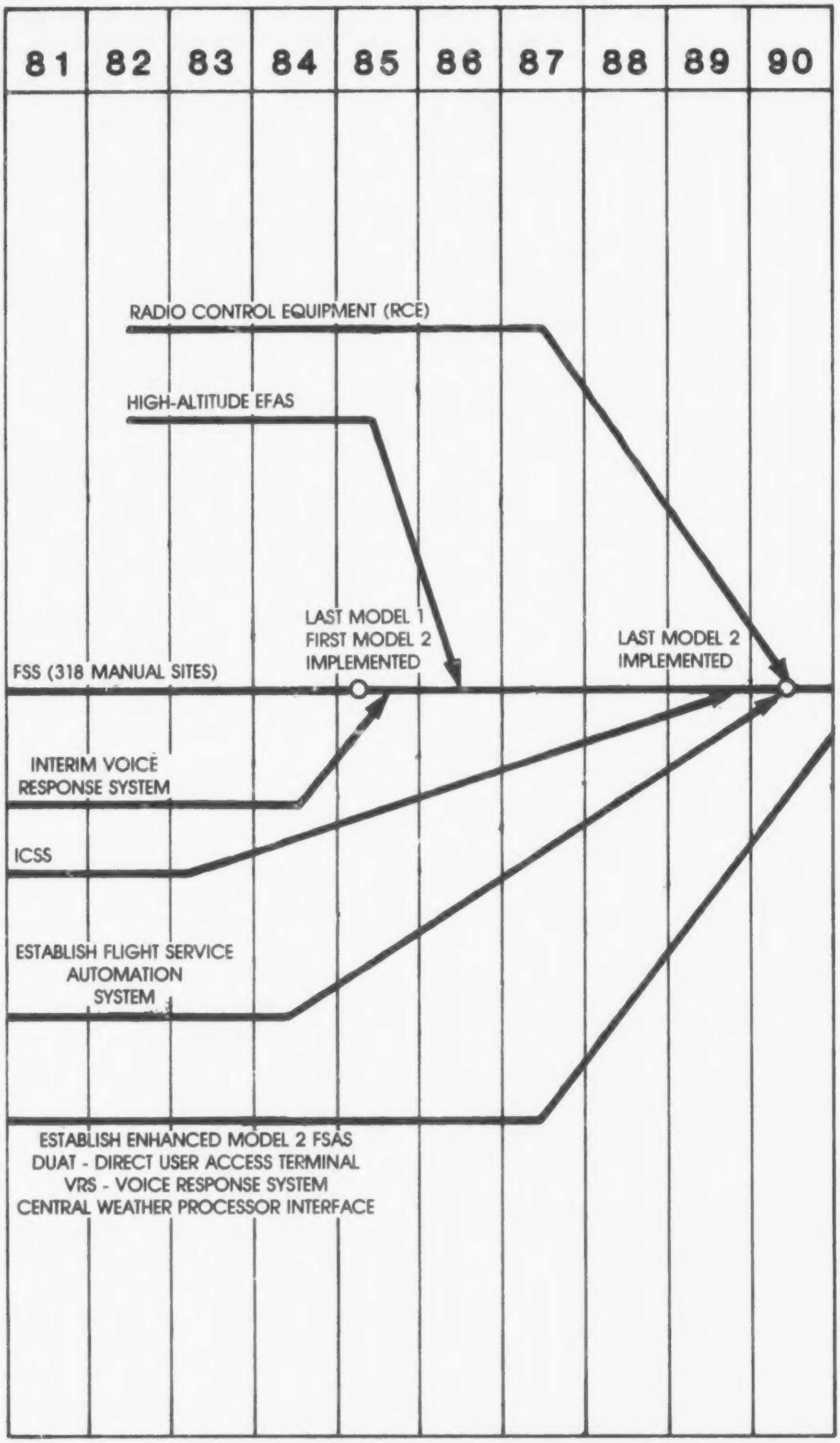
LONG TERM (TO 2000)

Mode S/data link coverage will be extended downward from 12,500 to 6,000 feet altitude above mean sea level, giving automated weather service to aircraft at lower altitudes.

The central weather processor will provide weather radar and weather data for air traffic control in ACFs and ATCTs and for AFSS use. The network of Doppler weather radars (NEXRAD) will be completed. This will improve the weather radar data available for automated air traffic control functions.

Programs based on current research to determine the effects that wind, wind gradient, turbulence factor, temperature, temperature gradient, pressure, and humidity have on the generation, transport, and decay of wake vortices may result in the solution of wake vortex hazards. Similarly, improvements in wind shear detection using Doppler radar and laser sensors may be implemented. Improved information regarding rates of falling rain, sleet, and snow; cloud heights; and lightning detectors for thunderstorm location may be provided.

The following diagrams and maps describe the evolution of the system.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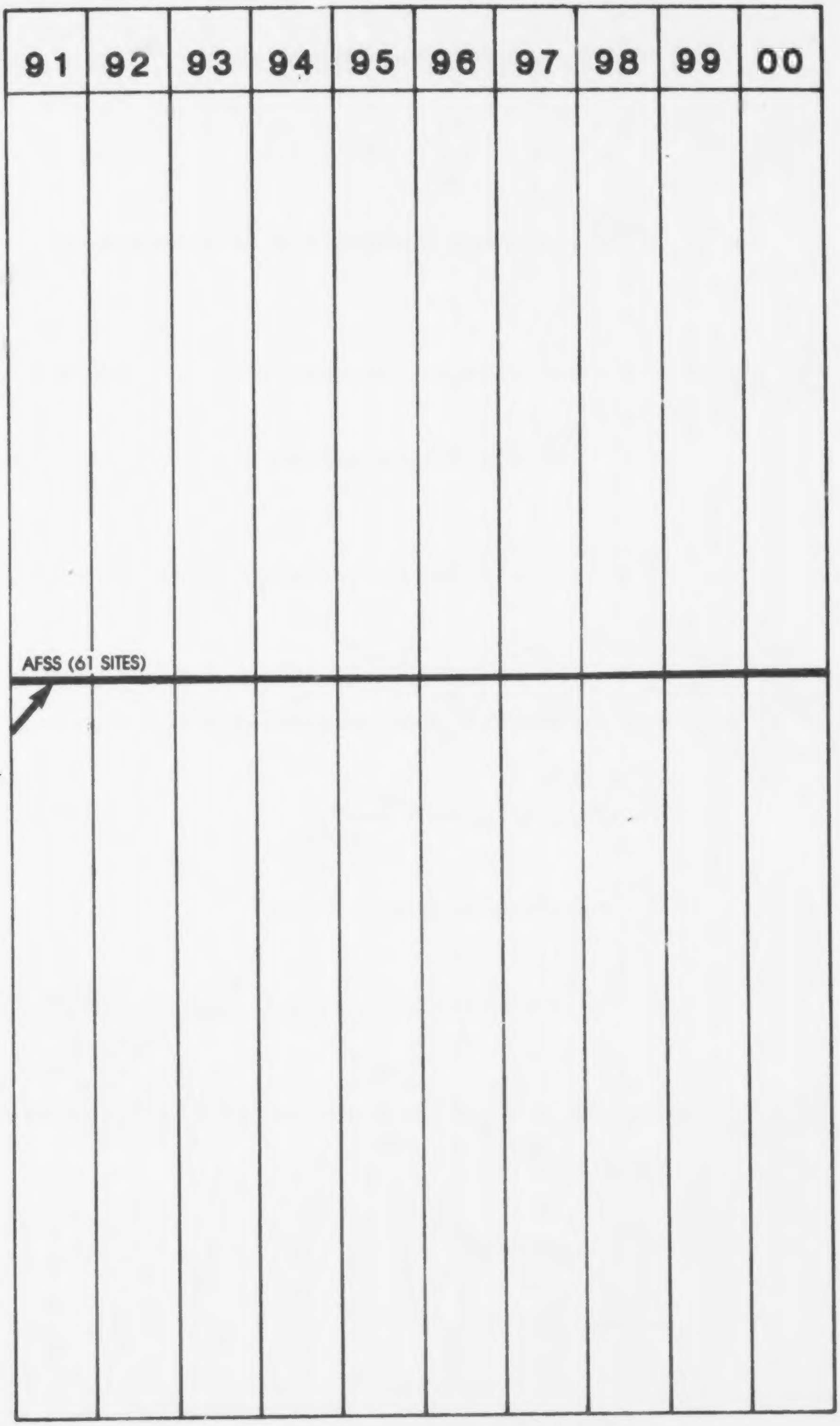
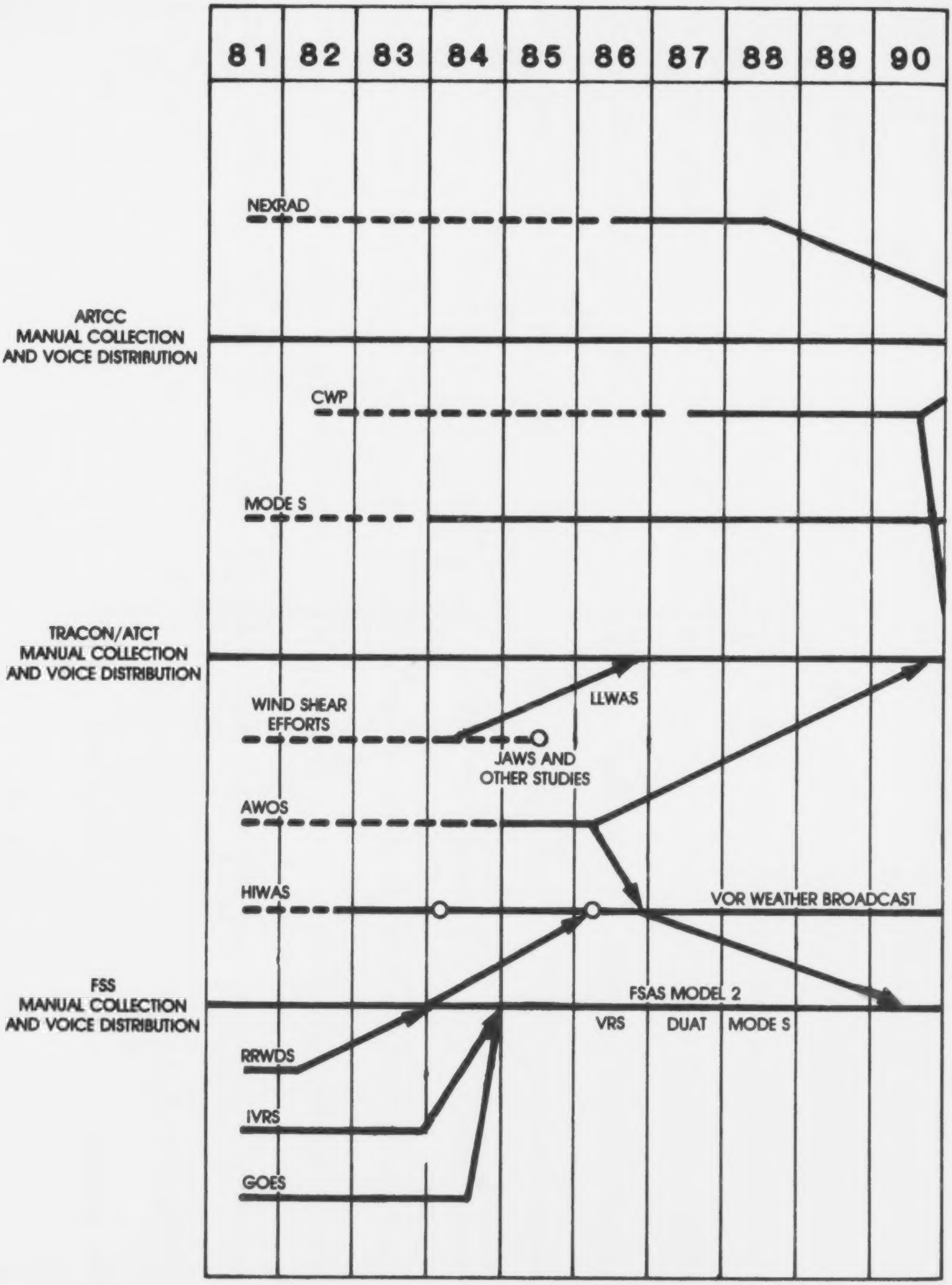
RADIO CONTROL EQUIPMENT (RCE)
HIGH-ALTITUDE EFAS
LAST MODEL 1
FIRST MODEL 2
IMPLEMENTED
LAST MODEL 2
IMPLEMENTED
FSS (318 MANUAL SITES)
INTERIM VOICE
RESPONSE SYSTEM
ICSS
ESTABLISH FLIGHT SERVICE
AUTOMATION
SYSTEM
ESTABLISH ENHANCED MODEL 2 FSAS
DUAT - DIRECT USER ACCESS TERMINAL
VRS - VOICE RESPONSE SYSTEM
CENTRAL WEATHER PROCESSOR INTERFACE



FLIGHT SERVICE SYSTEMS EVOLUTION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NEXRAD
ARTCC MANUAL COLLECTION AND VOICE DISTRIBUTION
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TRACON/ATCT MANUAL COLLECTION AND VOICE DISTRIBUTION
WIND SHEAR EFFORTS
LLWAS
JAWS AND OTHER STUDIES
AWOS
HIWAS
VOR WEATHER BROADCAST
FSS MANUAL COLLECTION AND VOICE DISTRIBUTION
FSAS MODEL 2
VRS
DUAT
MODE S
RRWDS
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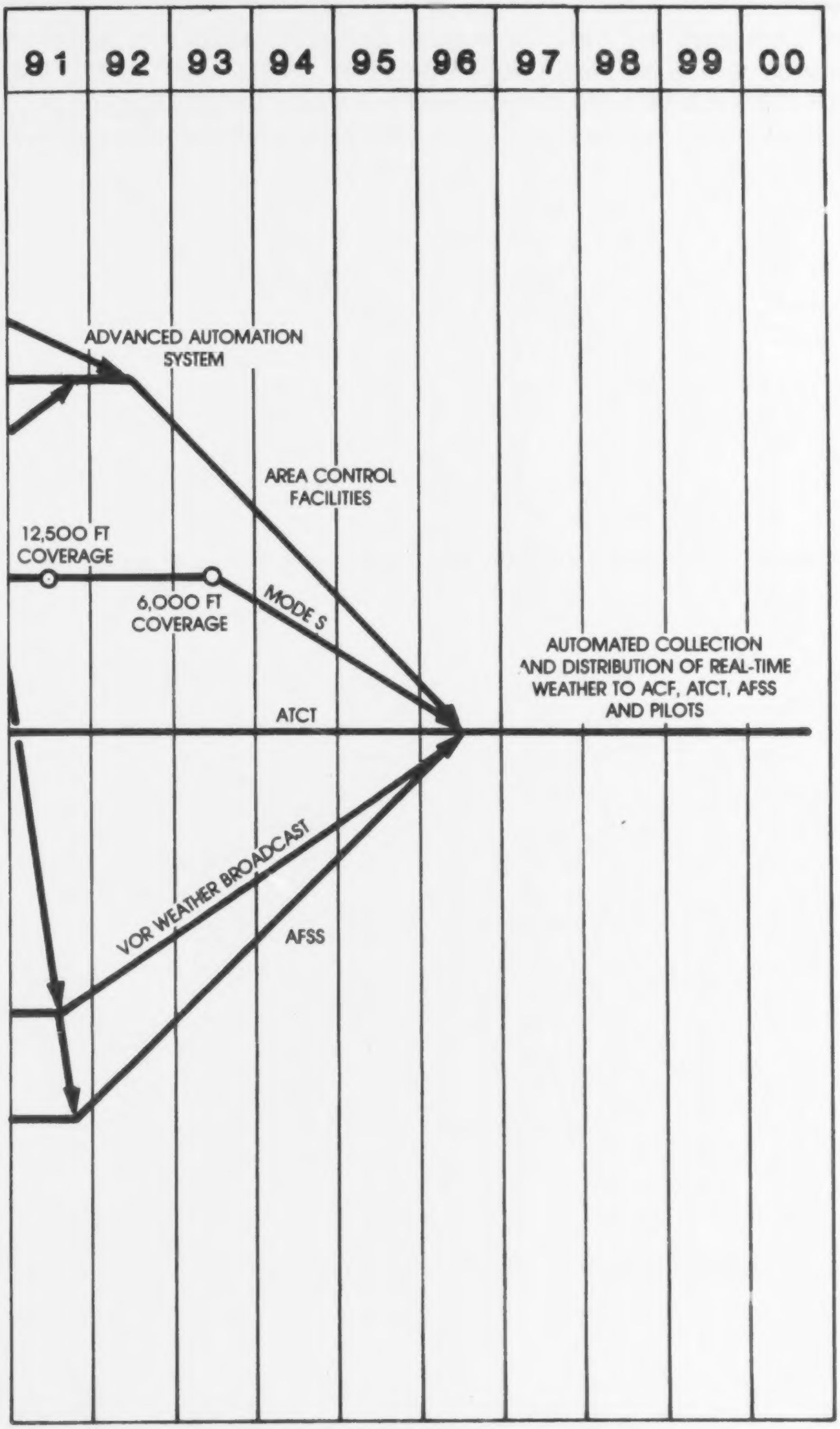
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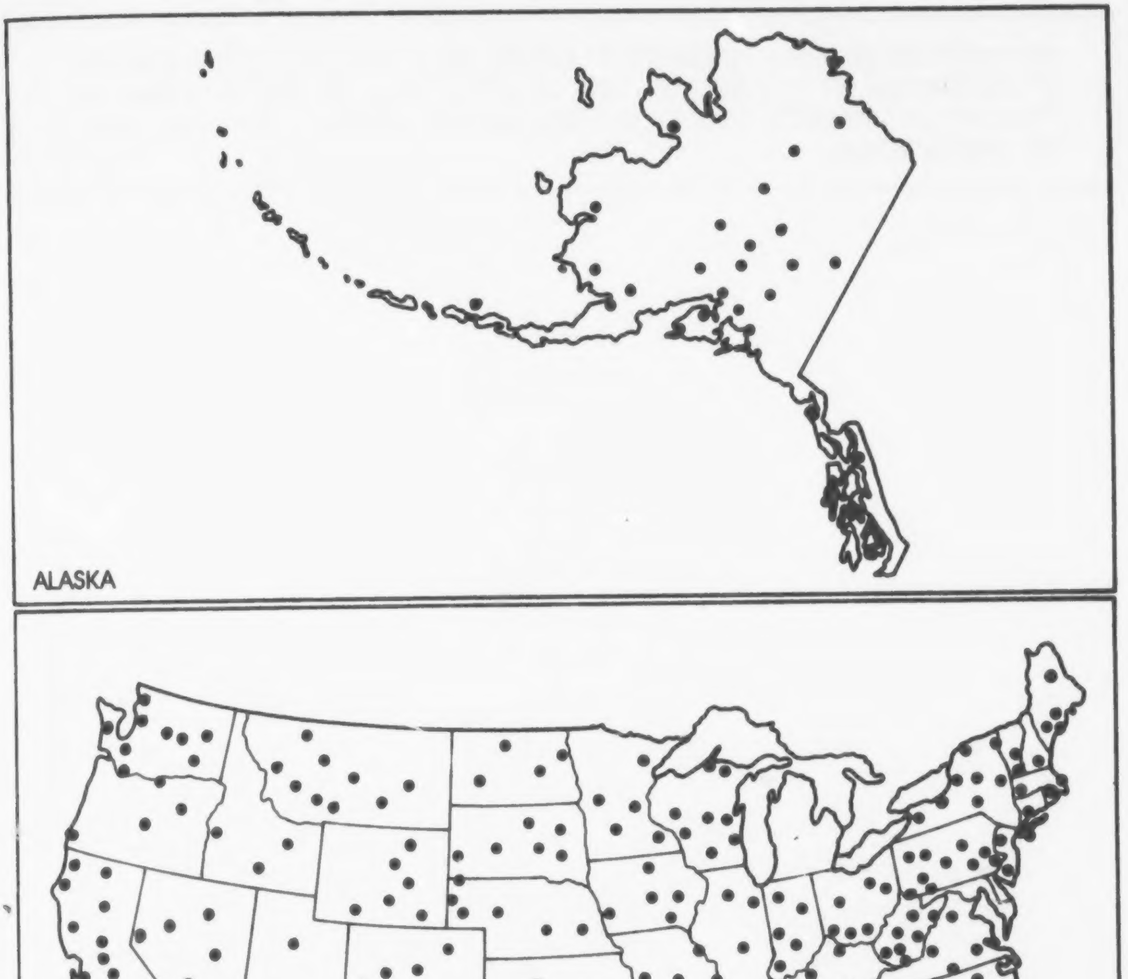
ADVANCED AUTOMATION SYSTEM
AREA CONTROL FACILITIES
12,500 FT COVERAGE
6,000 FT COVERAGE
MODE S
AUTOMATED COLLECTION AND DISTRIBUTION OF REAL-TIME WEATHER TO ACF, ATCT, AFSS AND PILOTS
ATCT
VOR WEATHER BROADCAST
AFSS

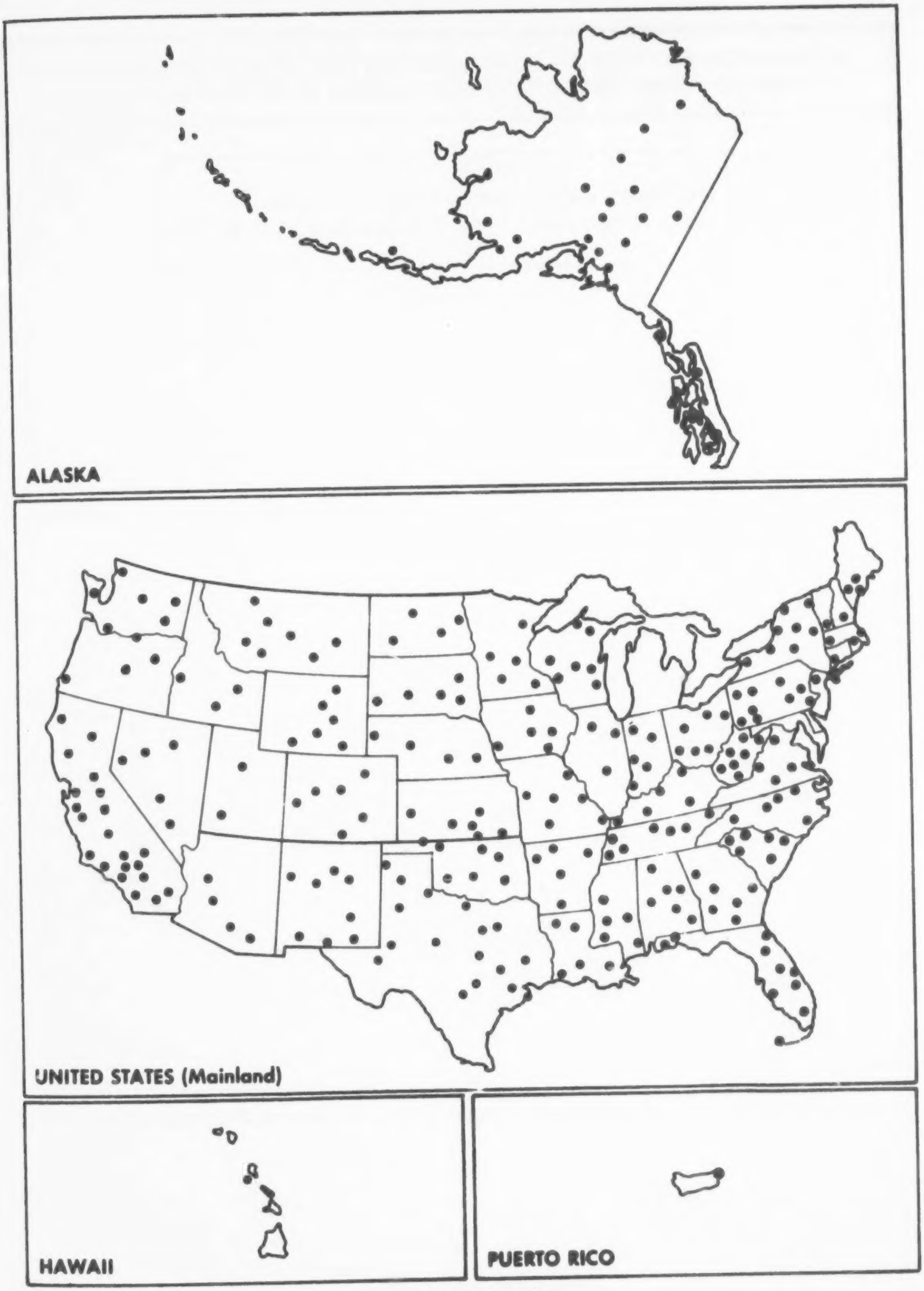
WEATHER SYSTEMS EVOLUTION

THE CURRENT SYSTEM CONSISTS OF 318 LABOR-INTENSIVE FLIGHT SERVICE STATIONS RANGING FROM VERY SMALL PART-TIME TO LARGE FACILITIES EMPLOYING APPROXIMATELY ONE HUNDRED PEOPLE.


ALASKA
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

1981 SYSTEM
FLIGHT SERVICE STATIONS

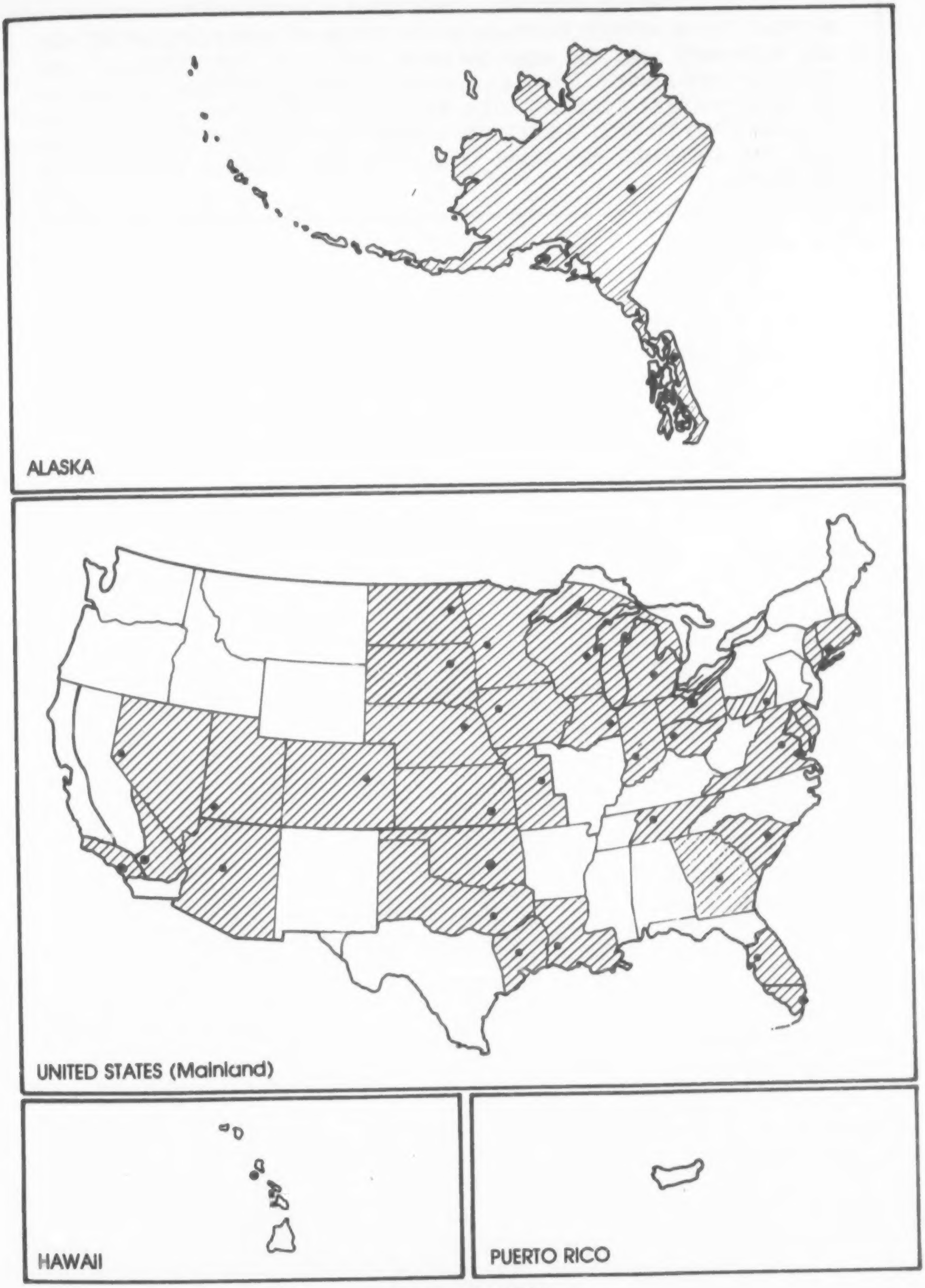
AUTOMATION OF FLIGHT SERVICE STATIONS AND FACILITY CONSOLIDATION IS UNDERWAY. BY THE END OF 1985, 24 AFSSs WILL BE OPERATIONAL, 63 FSSs WILL HAVE BEEN CONSOLIDATED, AND 239 MANUAL FSSs WILL STILL BE OPERATIONAL.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1985 SYSTEM
FLIGHT SERVICE STATIONS

AUTOMATION AND FACILITY CONSOLIDATION WILL RESULT IN 61 MODEL 2 AUTOMATED FLIGHT SERVICE STATIONS DRIVEN BY 23 FSDPSs.

HATCHED AREAS - AFSS SITES SELECTED
UNHATCHED AREAS - AFSS SITES TO BE SELECTED


ALASKA
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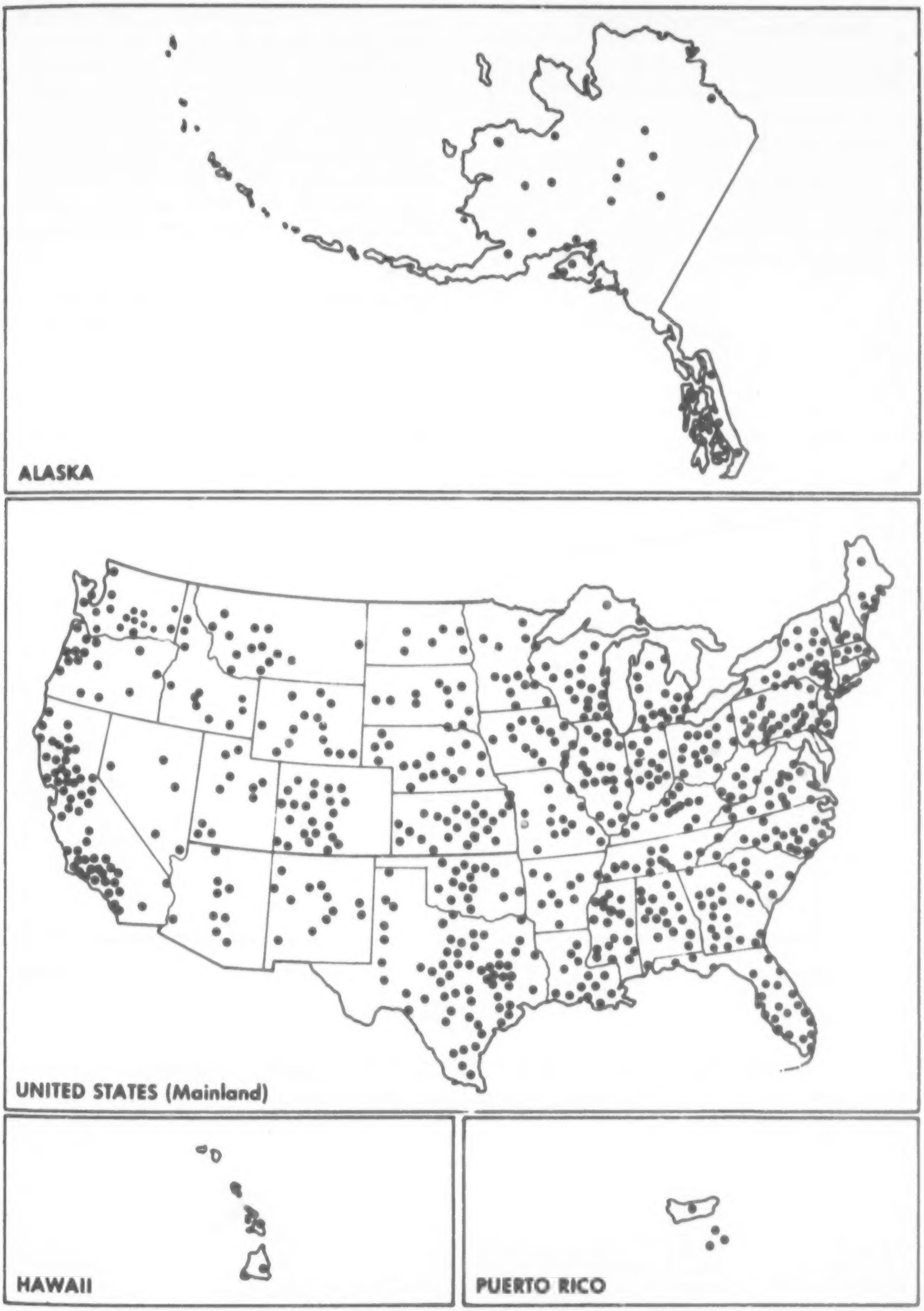
HAWAII
PUERTO RICO

**2000 SYSTEM
FLIGHT SERVICE STATIONS**

AUTOMATED WEATHER OBSERVATION SYSTEMS WILL BE F&E FUNDED FOR 300 TOWERED AND 400 NONTOWERED AIRPORTS. ADDITIONALLY, 400 NONTOWERED AIRPORTS ARE EXPECTED TO INSTALL AUTOMATED WEATHER OBSERVATION SYSTEMS WITH AIP FUNDS. WEATHER DATA WILL BE TRANSMITTED TO PILOTS OVER VHF OMNIRANGES AND TO CONTROLLERS AND THE WEATHER NETWORK OVER THE FAA TELECOMMUNICATIONS NETWORK.



ALASKA

UNITED STATES (Mainland)

HAWAII

PUERTO RICO

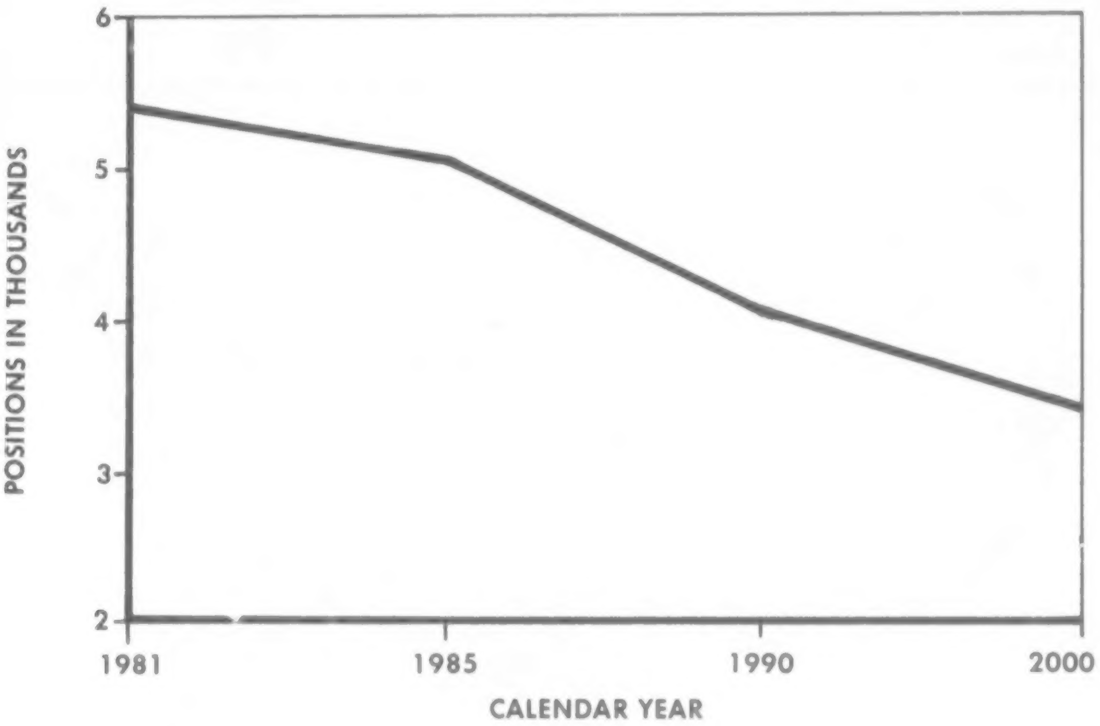
1990-2000 SYSTEM
AUTOMATED WEATHER OBSERVATION SYSTEM

RETURN ON THE INVESTMENT

As a result of these planned actions, FAA operations costs will be significantly reduced; productivity will increase; and, most important, FAA's service to the user will be substantially improved.

FAA FIELD EMPLOYMENT

By the year 2000, these changes will have the net effect of decreasing current Airway Facilities personnel requirements by 36 percent and current Air Traffic personnel requirements by 38 percent. Estimates of Air Traffic employment in the year 2000 are based upon new studies which indicate that 70 percent of the demand for FSS services will be accommodated by the automated systems. Previous years' estimates were based on automated systems accommodating 90 percent of demand.



AIR TRAFFIC/AIRWAY FACILITIES EMPLOYMENT
(FLIGHT SERVICE SYSTEMS)

SUMMARY OF FACILITY CHANGES

1981—Present Airway Facilities and Air Traffic employment for 979 facilities requires a total of 5,487 people.

1985—Air Traffic employment will decrease to 4,500 due to the interm voice response system and consolidation of manual flight service stations into automated stations. Airway Facilities staffing will decrease due to these consolidations and conversion to solid-state equipment.

1990—Further decreases in Air Traffic employment will result from continuation of the consolidation of facilities, and the completion of the Model 2 flight service data processing systems. Airway Facilities employment will also decrease due to facility consolidation and replacement of tone control and teletypewriter equipment.

2000—Further decreases in both Air Traffic and Airway Facilities occur due to the widespread acceptance of automated flight services and the removal of outdated weather systems resulting in a total field work force of 3,407 to operate and support 1,068 facilities.

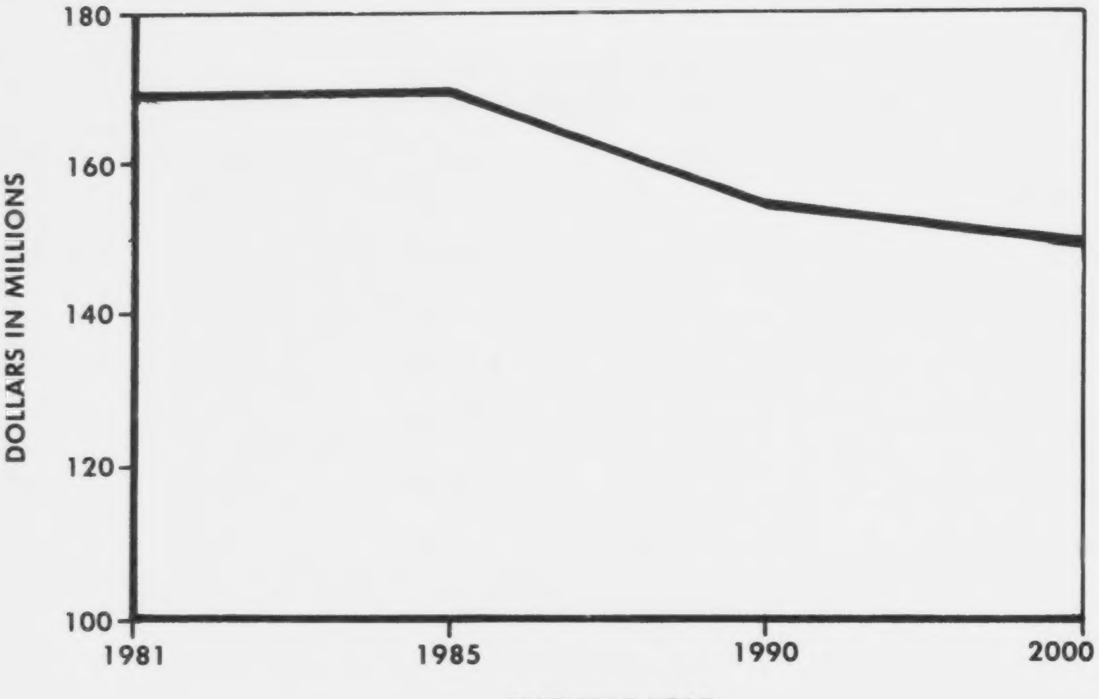
FLIGHT SERVICE SYSTEMS
AIR TRAFFIC/AIRWAY FACILITIES EMPLOYMENT CHANGES

	1981	1985	1990	2000
No. of Facilities	979	1026	1,228	1,068
Operations	62,600,000	64,200,000	80,600,000	101,000,000
Air Traffic Personnel	4,671	4,500	3,400	2,882
AT Productivity Quotient	13,402	14,266	23,705	34,045
Airway Facilities Personnel	816	726	605	525
AF Productivity Quotient	76,716	88,308	133,223	192,380
Total AF & AT Staffing	5,487	5,227	4,005	3,407

FIELD OPERATIONS COST

Operating costs are made up of estimated annual expenditures for field personnel, leased communications, rents and utilities, and other miscellaneous categories. The costs for each of the years in this plan are a direct consequence of the facility changes and their impact in these areas. Costs are in constant FY-81 dollars.

The personnel costs for Air Traffic are based on the expected number of flight service station specialists and support personnel required at flight service stations. The average salary cost for personnel for 1981, multiplied by the number of positions, determine the total Air Traffic personnel costs for each of the years in this plan.



OPERATIONS COSTS

Airway Facilities personnel costs are derived by multiplying the total number of employee-years associated with the maintenance of field equipment by the average cost of an electronic technician in 1981: $34,100. A single cost figure has been used here due to the current demography of the work force and the expectation that trainee technicians and administrative positions will remain small compared to the overall field work force. These costs are summarized at the end of this section.

Rents and Utilities: The table below is a summation of estimated annual expenditures for renting equipment; land and buildings; electrical, gas, and water services; etc. Rental and energy costs will increase in 1985 due to the transition to new facilities. These costs will decrease by 1990 due to the closing of nonautomated FSSs. By the year 2000, these costs will essentially remain constant. Energy costs are discussed in the following section.

Other. A summation of all other services not otherwise classified, such as storage of household goods, automotive maintenance and repair, aircraft rental, and repair of technical building facilities and grounds, etc.

The table below also summarizes annual operations costs in the flight service system.

FLIGHT SERVICE SYSTEMS OPERATIONS COSTS (000)

	1981	1985	1990	2000
Air Traffic Personnel	127,051	122,400	92,480	78,390
Airway Facilities Personnel	27,826	24,757	20,631	17,903
*Leased Communications	6,000	15,000	35,000	45,000
Rents & Utilities	3,335	3,612	2,800	2,430
Other	3,061	4,693	3,908	3,391
Totals	167,273	170,462	154,819	147,114

*Costs shown are best estimates at the time of publication. Actual costs may differ due to negotiated tariffs.

FSS leased communications costs consist of leased switching systems, weather sensor remoting circuits, and toll-free long-distance telephone services provided for system users. Changes expected are:

1981-1985—Costs will increase due to the AT&T divestiture and additional toll-free services required by consolidating 63 small FSSs into 24 initial AFSS facilities. The leased IVRS and ICSS equipment will further increase costs.

1985-1990—Costs will continue to rise as all but a few flight service stations are consolidated into 61 AFSSs. Longer-distance and more frequent toll charges will be incurred as general aviation activity increases. Purchases of ICSS equipment will reduce costs; but the addition of more than 600 AWOS sensors will more than offset the reduction, bringing about much higher circuit costs.

1990-2000—Costs will continue to rise despite full FAA purchase of leased equipment due to increased toll changes and additional weather remoting circuits. Costs are expected to level out early in this period.

ENERGY COSTS

Energy costs increase in 1985 due to additional equipment being installed throughout the country. As the FSSs are automated and older equipment is removed, the costs will gradually decrease to the level shown for the year 2000.

FLIGHT SERVICE SYSTEMS ENERGY DATA

	1981	1985	1990	2000
Energy (kWh $\times 10^6$)	50	66	36	28
Costs (Millions)	2.5	3.3	1.8	1.4

SPECIFIC PROJECTS

The plan calls for 13 separate projects to improve flight service station capabilities, falling under four basic categories: automation, mass weather dissemination, surveillance, and communications.

READEX
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PROJECTS	IMPLEMENTATION	
	FIRST	LAST
AUTOMATION		
1. Establish Flight Service Automation System (FSAS)	1984	1990
2. Central Weather Processor (CWP)	1990	1991
3. Consolidated NOTAM System (CNS)	1984	1984
4. Weather Message Switching Center (WMSC) Replacement	1988	1989
5. Weather Communications Processor (WCP)	1987	1989
MASS WEATHER DISSEMINATION		
6. Interim Voice Response System (IVRS)	1984	1985
7. High-Altitude En Route Flight Advisory Service (EFAS) Frequencies	1985	1986
8. Hazardous In-Flight Weather Advisory Service (HIWAS)	1984	1986
SURVEILLANCE		
9. Automated Weather Observation Systems (AWOS)	1986	1990
10. Radar Remote Weather Display System (RRWDS)	1982	1984
11. Geostationary Operational Environmental Satellite (GOES) Recorders	1984	1984
12. Wind Shear Efforts	1984	1986
COMMUNICATIONS		
13. Integrated Communications Switching System (ICSS)	1983	1992

PROJECT SUMMARY

PROJECT 1: Establish Flight Service Automation System (FSAS)

Purpose: This project will improve user access to weather information and NOTAMs, simplify flight plan filing, and provide a flight service station automation system that will meet the projected increases in demand for flight services without proportional increases in staff.

Approach: Automation is to be developed and implemented in three steps: Model 1 (limited specialist automation), Model 2 (full specialist automation with limited direct user access capability), and Model 2 enhancements (full direct user access capability).

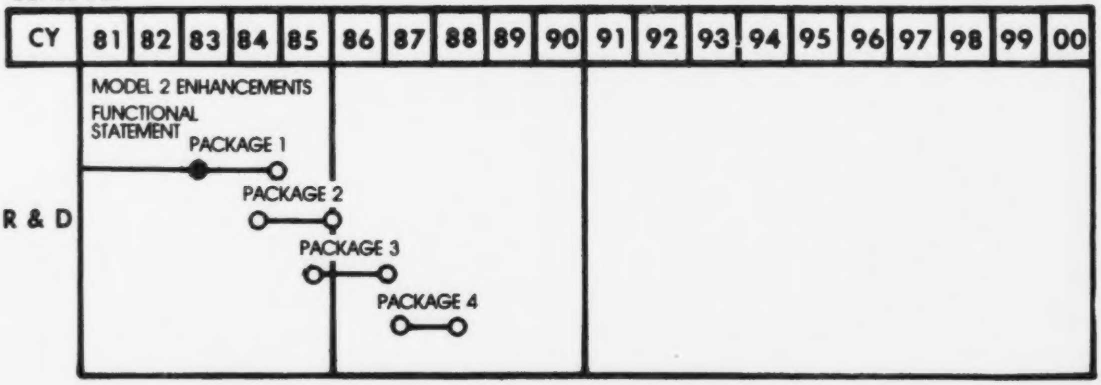
The software design of the Model 1 system has exceeded FAA's expectations, and an alternative approach to automation system development and implementation now appears very advantageous. Under this alternative, Model 2 would be developed in discrete steps building on the base provided by the Model 1 design, thereby, reducing the risk involved in the development of Model 2. This alternative will be examined in the initial audit of the NAS Plan by the System Engineering and Integration Contractor.

Implementation of the automated system is expected to be completed by the 1990 time frame. By that time, pilots will have the capability to directly access the flight service automation system (FSAS) through a variety of self-briefing techniques for preflight and in-flight weather briefings and initiate flight plan filing.

Enhancements to Model 2 FSAS for enhanced direct user access capability, etc., will be provided through concept development, test, evaluation, and systems specification. The approach will be to evaluate enhancement concepts and specify the functional requirements as enhancement packages to be integrated into the Model 2 FSAS. Expected enhancement packages at this time include the following:

- Package 1—Voice response system (VRS) self-briefing terminal access, ground-to-air transmission of local area weather.
- Package 2—Aviation route forecast center weather service unit interface, flight plan filing and expanded VRS weather products, development of interfaces for the Mode S/data link system.
- Package 3—Improved FSS specialist aids, additional meteorological products and expanded direct user access terminal (DUAT) functions.
- Package 4—Broadcast in-flight weather data via VHF omni-range, automatic direction finder flight service automation system computation, new central flow control facility interface/functions, voice recognition for VRS, weather data transmission over VOR, and automated data base processing.

SCHEDULE



The following is planned for FSS consolidation:

End of Year	To Be Consolidated	Remaining*	AFSS Commissionings	AFSS Cumulative Total
1983	5	311	2	2
1984	29*	278	5	7
1985	29	239	17	24
1986	49	188	10	34
1987	66	121	11	45
1988	54	67	7	52
1989	35	32	5	57
1990	32	0	4	61

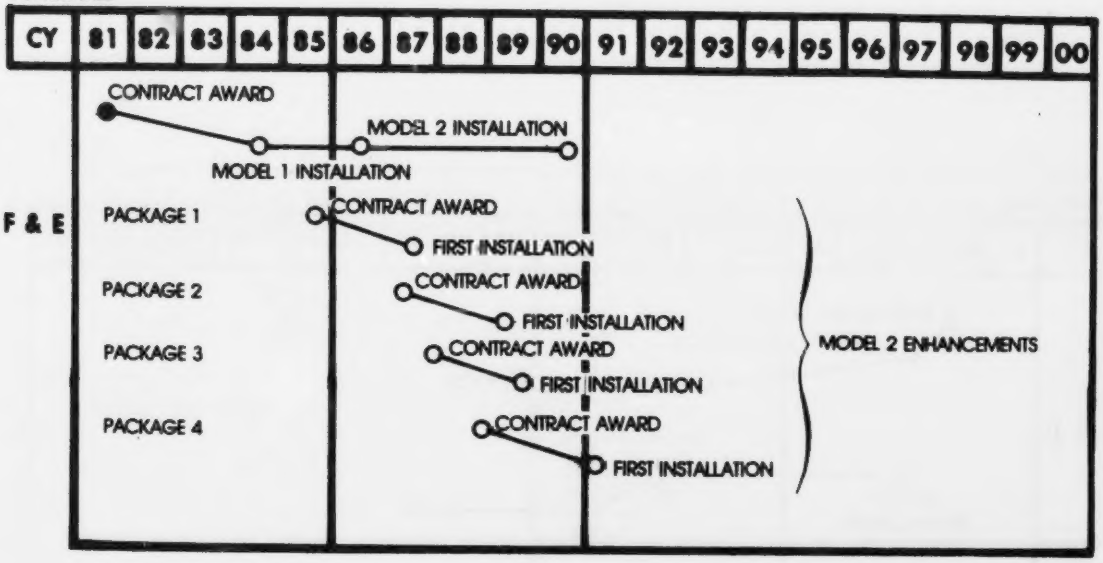
*FSS consolidation figures are planning estimates. When an existing FSS location is also the AFSS site, that FSS is relocated rather than consolidated. The actual number of consolidations in a given year will be dependent on congressional approval.

Products:

- Model 1.
  - — 13 flight service data processing systems (at ARTCCs).
  - — 37 FSSs equipped with automation position equipment.
- Model 2.
  - — 2 aviation weather processors (at NADIN switching centers).
  - — 23 total flight service data processing systems (at ARTCCs/ACFs).
  - — 61 automated flight service stations.
- Model 2 Enhancements. Enhancement hardware and/or software will be procured for use at all 61 Model 2 automated flight service stations (AFSS).

Related Projects/Activities: Flight service facilities space for the 61 automated flight service stations will be acquired on a sponsor-provided leased basis at selected airports in the United States and Puerto Rico. The 61 new facilities will house FSAS specialist automation positions and the other equipment necessary to satisfy FSS system requirements. The weather communication processor; ICSS; NAS spectrum engineering; DF modernization; and CWP support the establishment of enhanced flight services.

SCHEDULE



PROJECT 2: Central Weather Processor (CWP)

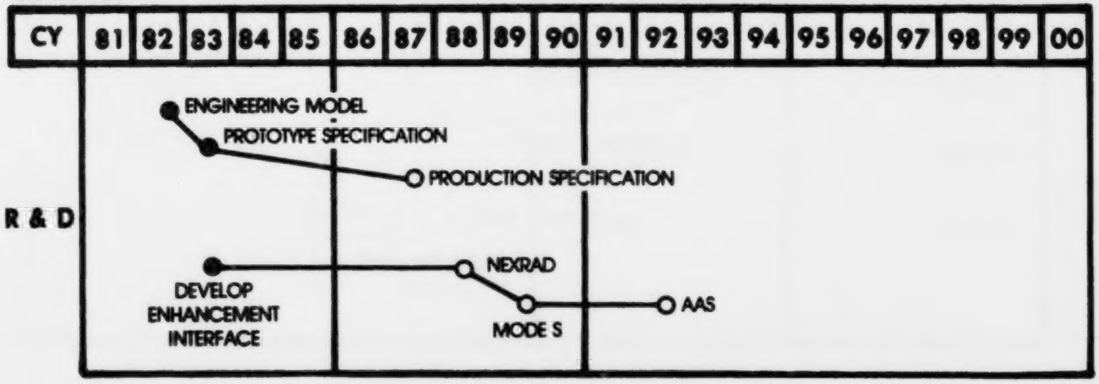
Purpose: This project will improve the collection, synthesis, and dissemination of weather information throughout the National Airspace System to pilots, controllers, flight service station specialists, and meteorologists. This project provides the CWSU meteorologist with an automated work station greatly enhancing their ability to analyze rapidly changing, potentially hazardous weather conditions and ensures the latest and best information is provided to all system users. It also provides for the mosaic of multiple radars. These improvements are deemed necessary to reduce the high percentage of accidents and air traffic delays directly related to weather.

Approach: Since major improvements are needed in the quality of weather information and the speed of its dissemination, this project will proceed in two phases: (1) simplifying the collection of data and automating many of the CWSU work station functions, and (2) developing, testing, validating, and integrating enhancements which are heavily dependent upon other NAS Plan projects under development. Prototype and production systems will be procured. Field implementation will start in 1990. Subsequent enhancements will accommodate NEXRAD, the Advanced Automation System, and Mode S/data link.

Products: F&E—26 Model 1 production systems, including documentation and logistics support (23 to ACFs, one to traffic management system, one to FAA Academy, and one to FAA Technical Center (support facility)).

Related Projects/Activities: FSDPS, RRWDS/NEXRAD, FAA telecommunications network, WMSC Replacement, WCP, ASR 9 Wx channel, NOAA/ERL/PROFS.

SCHEDULE



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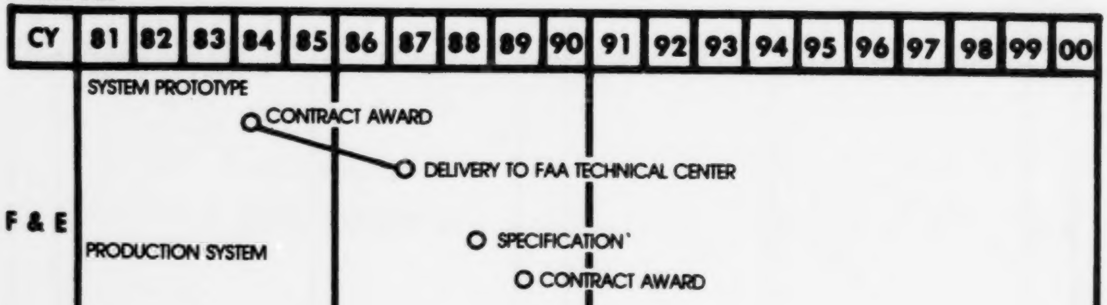
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DELIVERY TO FAA TECHNICAL CENTER
PRODUCTION SYSTEM
SPECIFICATION
CONTRACT AWARD
IMPLEMENTATION

PROJECT 3: Consolidated NOTAM System (CNS)

Purpose: The purpose of the CNS processing system is to: receive notices to airmen (NOTAM) data from FAA and ICAO facilities; provide request and reply service to subscriber stations; correct, reformat, and validate NOTAMs as necessary; automate NOTAM editing process; monitor and delete NOTAMs automatically; and increase NOTAM statistic reporting capability.

Approach: The CNS has been designed to interface with the National Data Interchange Network (NADIN) communications system as the primary input and distribution media for all users. A communication interface between the NOTAM system and other distribution processors may be approved by the agency on a case-by-case basis.

The system provides for individual accountability for all reportable facilities (excluding nondirectional beacons) and for facilities serving airports and allows dynamic modification of distribution patterns, automatic translation or encryption of distribution patterns, and automatic translation or encryption of data entered in NOTAM code or properly formatted abbreviated text. The CNS central processors are redundant IBM 4331 Model II computers. These are attached to redundant IBM Series 1 communications "front-end" minicomputers. These systems are arranged so that either 4331 can access either Series 1 or vice versa. The 4331's also exchange status and data synch information. Minimum data transfer speed between the systems is 56,000 bits per second.

Final interface requirements between the CNS and other agency programs are under development; i.e., the weather message switching center (WMSC) replacement and AWP/FSDPS systems.

Products:

- 2 IBM 4331-2 processors.
- 2 IBM 4955 Series 1 minicomputers.

Related Projects/Activities: WMSC Replacement, FAA telecommunications network, AFTN, military interface. This project appeared in the 1983 edition under Relocation of NATCOM Functions.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
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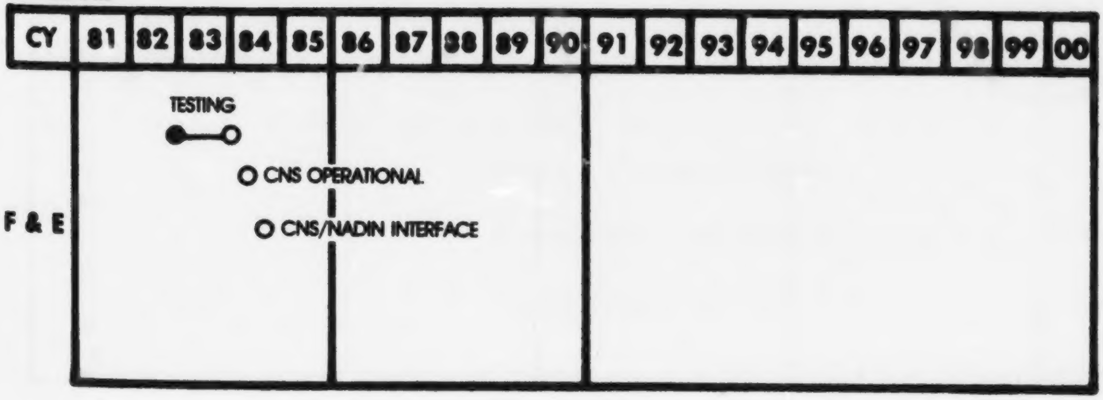
SCHEDULE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CNS OPERATIONAL
CNS/NADIN INTERFACE

PROJECT 4: Weather Message Switching Center (WMSC) Replacement

Purpose: This project will replace the weather message switching center (WMSC) with state-of-the-art equipment and technology to perform all current alphanumeric data handling functions of the WMSC, excluding NOTAM processing. It will provide procedural transparency for present WMSC users and rely on NADIN for circuit connectivity. Further, the system will also accommodate graphic data and function as the sole FAA gateway to the National Meteorological Center (NMC) and, therefore, will be the source of National Weather Service products for the NAS.

Approach: Two systems will be procured for turnkey installation. The WMSC replacement will have nodes co-located with the NADIN switches (Atlanta and Salt Lake City) to provide geographic redundancy. Each node will have identical capabilities so that weather information distribution will continue in the event of a complete node failure. The implementation of the WMSC replacement will allow the closing of the National Communications Center (NATCOM). Upon closing, the NATCOM building will be refurbished for GSA.

Products: WMSC replacement processors and related peripherals to be located at each of the two NADIN switch sites.

Related Projects/Activities:

- AWP—the WMSC replacement will transmit weather products from the NMC to the AWP.
- NADIN—NADIN will provide the telecommunications interface for the WMSC replacement and its indirect interfaces.
- CWP—the WMSC replacement will transmit weather products from the NMC to the CWP.
- This project appeared in the 1983 edition under the title relocation of NATCOM Functions.

SCHEDULE

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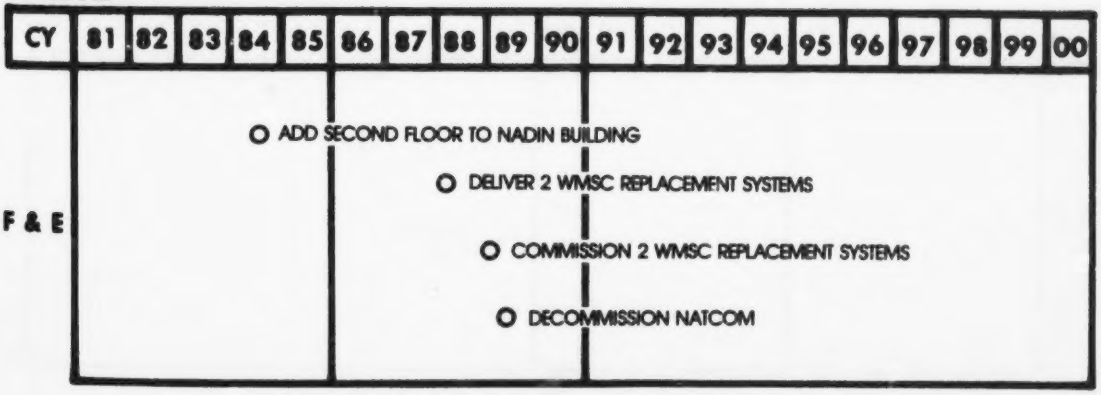
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ADD SECOND FLOOR TO NADIN BUILDING
DELIVER 2 WMSC REPLACEMENT SYSTEMS
COMMISSION 2 WMSC REPLACEMENT SYSTEMS
DECOMMISSION NATCOM

PROJECT 5: Weather Communications Processor (WCP)

Purpose: The WCP has two primary functions:

- Collect, process, and disseminate data from automated sources of weather observations; i.e., AWOS.

- Interface with the Mode S/data link system to generate reply messages in response to requests for weather data.

Approach: The development, test, evaluation, and subsequent procurement will be accomplished by competitive contract. The essence of the WCP is software and the SEI contractor will be tasked to assure that the functions are fully integrated.

Products: 25 WCPs—23 to ACFs, one to the FAA Academy, and one to the FAA Technical Center.

Related Projects/Activities:

- AWOS—the WCP will collect, process, and distribute data from the AWOS.

- Mode S/Data Link—the WCP will interface with the data link for weather information requests and assemble the required weather messages.

- CWP and FSDPS—the WCP will interface with other elements of the ACF weather processor complex to exchange data.

- VORs and UHF outlets—the WCP will assemble and direct AWOS-based broadcast messages to the designated UHF or VOR outlets.

- This project, although new to this year's edition, expands the concepts for data link and weather distribution contained in the 1983 edition.

SCHEDULE

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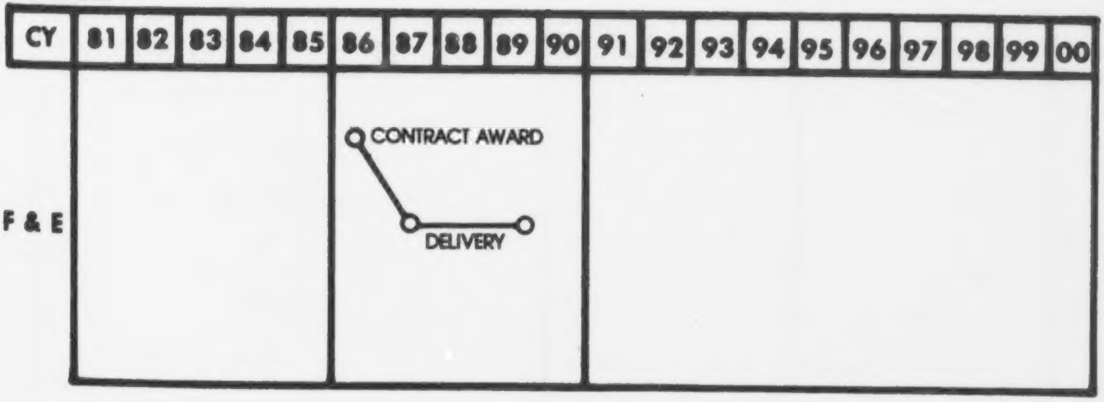
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PROJECT 6: Interim Voice Response System (IVRS)

Purpose: The interim voice response system for pilot self-briefing will permit pilots in the continental United States (CONUS) to retrieve information directly from an automated weather data base by telephone. This will assist in meeting the demand for service during the transition to FSS automation.

Approach: A procurement request was issued in 1983 for installation, maintenance, and operation of a national system. Implementation is scheduled to begin late in 1984 and be completed within 8 months. The entire system will be leased using operations funding and will provide service for 27 main metropolitan areas. IVRS will provide the following information: alert weather watch, convective significant meteorological information (SIGMET), hourly surface observations, terminal forecasts, winds aloft forecasts, and transcribed weather broadcast (TWEB) route forecasts. This information will be retrieved through an interface with the WMSC.

Products:

- A contractor-supported computer/communication network consisting of one central site system (5 computers) and 15 remote speaking sites.
- Twelve additional metropolitan areas to have access via foreign exchange telephone company service.

Related Projects/Activities: FSAS—the first improvement package for FSAS Model 2 in early 1986 provides for a VRS service. IVRS will be continued until Model 2 VRS service can replace the service to area users.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
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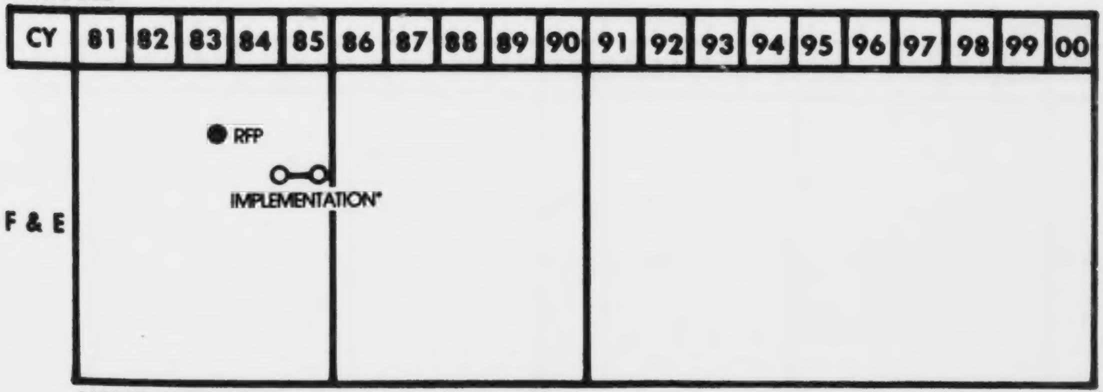

* LEASED SYSTEMS OPS FUNDED ON AN ANNUAL BASIS

PROJECT 7: High-Altitude En Route Flight Advisory Service (EFAS) Frequencies

Purpose: This project will provide a clear communications channel at 18,000 feet and above for the collection and dissemination of pilot reports (PIREP) and en route weather information.

Approach: Initiate action to procure, install, and operate a national system based on the success of the high-altitude test in the western United States. Establish frequencies in addition to the present en route flight advisory service (EFAS) 122.0 MHz, and stratify frequencies according to altitude. The new frequencies would be protected from adjacent flight watch control station (FWCS) frequencies to reduce frequency overlap problems. Implementation for 20 FSS EFAS or AFSS EFAS facilities will use approximately 60 communications outlets selected in accordance with plans for air-ground communications facility consolidation. As FSS consolidation proceeds, service will be provided from 20 AFSSs.

Products: Approximately 60 communications outlets controlled from FSS EFAS locations will be established.

Related Projects/Activities: Frequency and spectrum engineering; communications facility; consolidation.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
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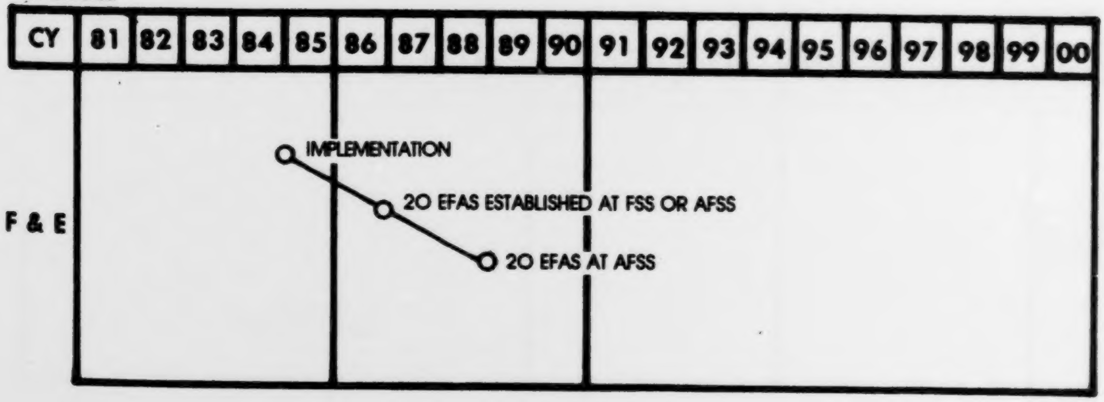
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IMPLEMENTATION
20 EFAS ESTABLISHED AT FSS OR AFSS
20 EFAS AT AFSS

PROJECT 8: Hazardous In-Flight Weather Advisory Service (HIWAS)

Purpose: This project will provide continuous prerecorded broadcasts of weather advisories over selected VORs. Weather advisories include: significant meteorological information (SIGMET), convective SIGMETs, airmen's meteorological information (AIRMET), and significant PIREPs. HIWAS broadcasts will relieve air traffic controllers and flight service specialists from the labor-intensive task of broadcasting these weather advisories and improve the timeliness of dissemination.

Approach: A test was conducted in the Southern Region using 13 VOR locations in the Miami and Jacksonville ARTCC areas. Additional testing is scheduled at Atlanta and Houston ARTCCs to assure all operational requirements will be met. Nationwide implementation is anticipated to begin in FY-85 using sufficient VORs to provide communications coverage at and above 4,000 feet agl.

HIWAS will replace the 3-minute single-tape TWEB service now being provided by selected FSSs. The HIWAS VOR outlets will be selected to avoid competition for VOR voice features that are required for AWOS. The HIWAS recordings will be prepared manually by FSS specialists using solid-state recorders allowing 4-minute capacity. Manually prepared HIWAS will begin to disappear when the FSS Model 2 equipment can generate a computer voice product to provide an equal or better service.

Products: Recording equipment will be provided at a number of FSS locations to provide continuous broadcasts over selected VORs. It is estimated that at least seven FSSs in each ARTCC area will prepare HIWAS broadcasts. The number of FSSs with HIWAS responsibility will decrease with the consolidation of FSSs.

Related Projects/Activities: FSAS—the manually prepared HIWAS will gradually be replaced by automated broadcasts available from FSAS enhancements. FSS consolidation will reduce the number of FSSs supplying manual HIWAS broadcasts. Frequency and spectrum engineering will protect frequency allocation.

SCHEDULE

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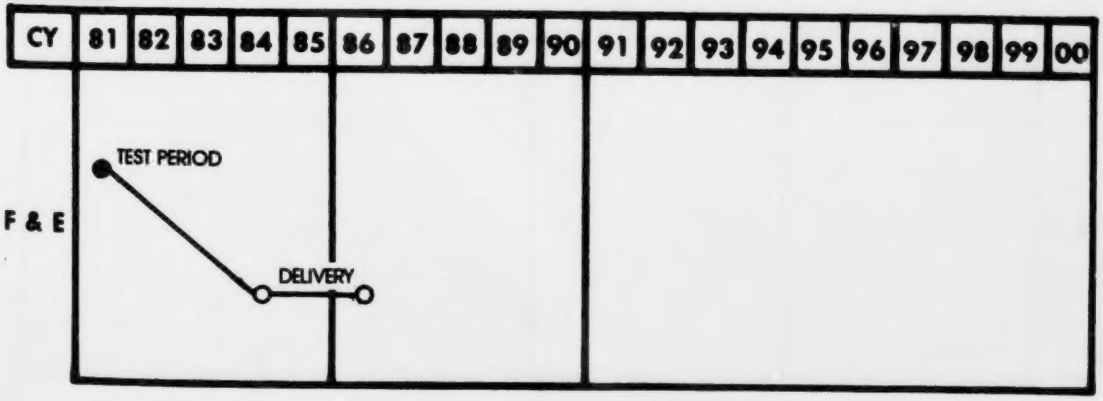
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PROJECT 9: Automated Weather Observation Systems (AWOS)

Purpose: AWOS will obtain aviation critical weather data (e.g., wind velocity and direction, temperature, dew point, barometric pressure, cloud height, visibility, and precipitation occurrence and accumulation) through the use of automated sensors, process the data, and allow the dissemination of this information to users. Four different distribution methods are envisioned, each tailored to unique user needs. Weather observation data must be available to airborne pilots on a timely basis for safety and efficiency. Additionally, timely observations are essential to improved forecasting.

Approach: AWOS dissemination methods to be tested are:

- Computer-synthesized voice broadcast over a VHF communication outlet (VOR or discrete frequency) which is updated once each minute.

- Flight service station specialist and direct user telephone access through the flight service automation system (FSAS). Prior to FSAS establishment, local AWOS data will be directly displayed to specialists.

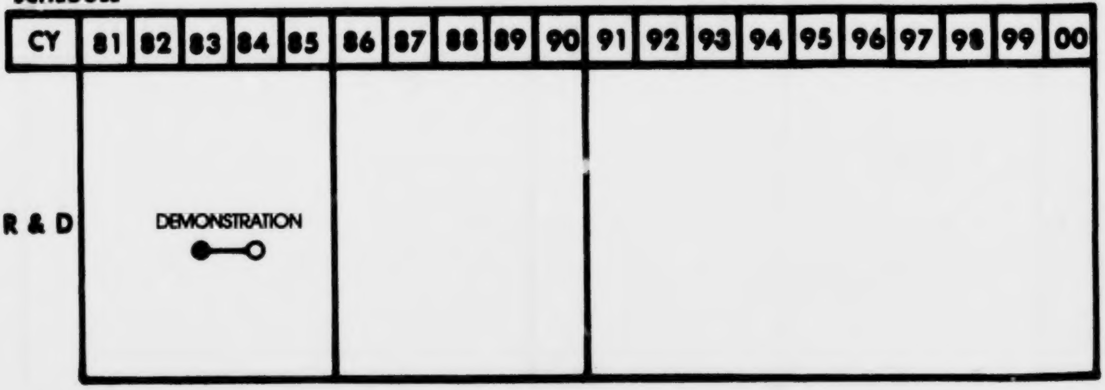
- ATCT controller access to local AWOS data through the use of cathode-ray tubes with manual entry devices (MED) located in ATCTs. Data being displayed will be the current data broadcast by AWOS.

- Entry transmission into a national network for ATC application and Mode S users.

The acquisition of AWOS will be accomplished in two phases using competitive procurement procedures. Contracts for the 14-system demonstration phase were awarded in December 1982. The demonstration phase began in July 1983 and will run through July 1984. During this phase, the production specification will be completed and procurement initiated. Implementation of the production system will begin by late 1986 and be completed by 1990.

Specifications developed will also allow the acquisition of affordable AWOS sensors, processors and display devices by airport operators, fixed base operators, heliport operators, etc., for their needs.

SCHEDULE



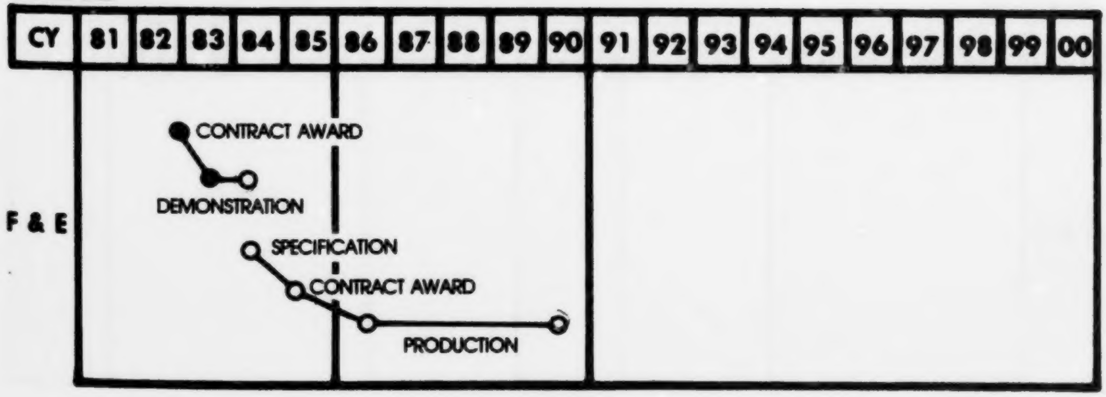
Products:

- 400 nontowered airports (F&E funded).
- 300 towered airports (F&E funded).
- 400 nontowered airports (AIP funded).
- 4 heliports (demonstration).
- 600 local.

Related Projects/Activities:

- VOR network and consolidated communication facility implementation—AWOS data will be broadcast through VOR or discrete VHF depending on cost-effectiveness.
- ATIS—AWOS-generated data will be furnished to ATCTs on a display for the controllers use in the preparation of ATIS broadcasts.
- FSAS—AWOS data will be supplied to flight service station specialists through the flight service automation system.
- FAA telecommunications network—AWOS data will be nationally transmitted through the FAA telecommunications network.
- Weather Communications Processor—AWOS data for national distribution and Mode S application will be collected/routed by this processor.
- Central Weather Processor and Advanced Automation Systems—AWOS data will be part of the data base used by CWSU meteorologists and supplied to air traffic controllers in area control facilities.
- Mode S/Data Link—AWOS information will be part of the services being transmitted to pilots who utilize Mode S/data link.
- Rotorcraft program—AWOS development will support the surface observation needs of FAA's rotorcraft program.
- NAS spectrum engineering.

SCHEDULE



PROJECT 10: Radar Remote Weather Display System (RRWDS)

Purpose: This project will provide improvements to the display of radar weather information in order to increase flight safety. Real-time weather and intensity levels are being provided to the center weather service units at ARTCCs, 44 FSS EFAS locations, and 2 non-EFAS FSSs. Provision of such capabilities has been supported by the National Transportation Safety Board (NTSB).

Approach: Seventy-seven National Weather Service and 57 FAA long-range radars have been funded to be equipped with RRWDS transmitters. The real-time weather information obtained is being remoted to acquired high-resolution raster scan displays. Additional leased communications circuits are used for narrowband transmission to ARTCC and manual FSS indicator sites.

With the installation of Model 2 FSAS, RRWDS data may be provided to non-EFAS AFSS specialists.

When the CWP becomes operational, RRWDS data may be provided to the CWP for use in ACFs as well as AFSSs. The EFAS position will receive direct RRWDS color radar data, and other specialists will receive black and white data at their positions, until RRWDS is replaced by NEXRAD.

Products: Items delivered:

Transmitter Site	No. of Items
Type I ARSR 1 & 2	29
Type II FPS Series	17
Type III ARSR 3	11
Type IV NWS WSR 57	50
Type V NWS WSR 74	27
Total	134

Indicator Site	
Site locations	77
Processors	151
Total	228

Related Projects/Activities:

- CWP—RRWDS will supply digital weather radar data to the CWP.
- NEXRAD—implementation of NEXRAD will replace RRWDS.

SCHEDULE

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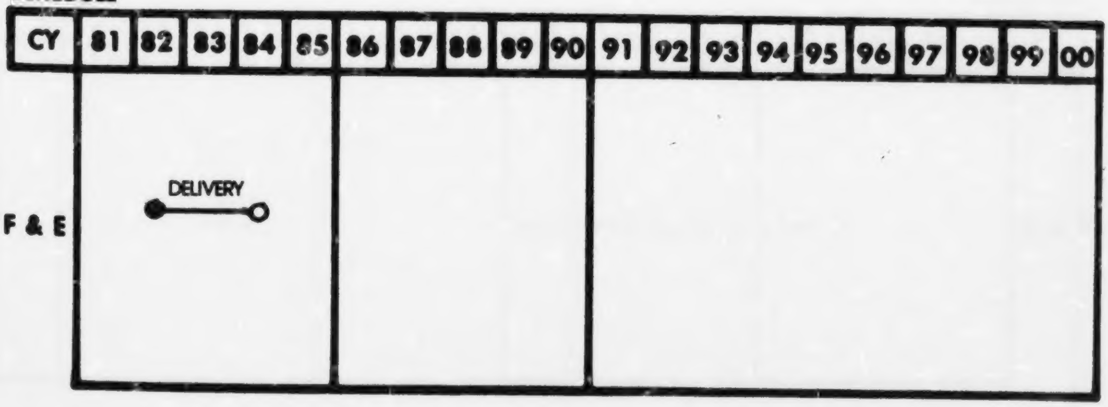
SCHEDULE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PROJECT 11: Geostationary Operational Environmental Satellite (GOES) Recorders

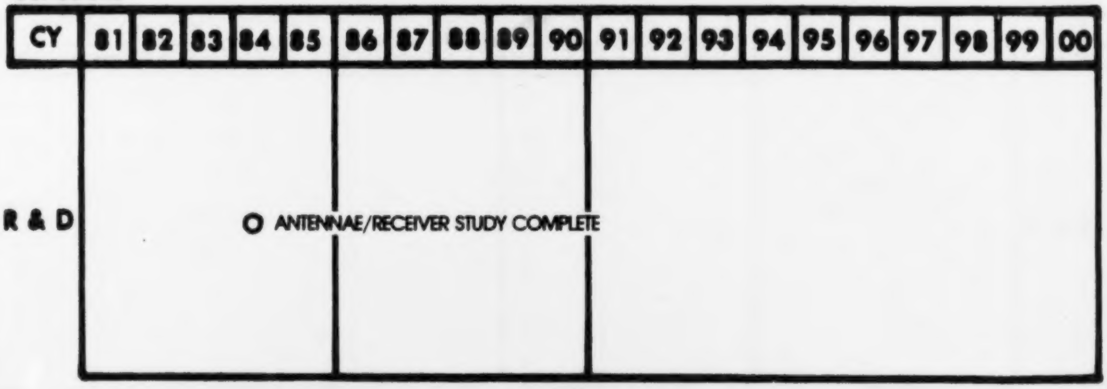
Purpose: Certain weather information (such as cloud cover, freezing levels, and weather system location and movement) is currently obtained from various sources; e.g., surface observations, radiosonde observations, and pilot reports. The information provided is incomplete. GOES facsimile recorders provide timely satellite weather information for more complete pilot briefing and en route advisories. GOES recorders can provide updated weather pictures to FSS specialists every 30 minutes, 24 hours a day.

Approach: GOES recorders have been purchased to supply all CWSU locations and will be purchased for 61 AFSSs, the FAA Academy, and the FAA Technical Center. Because the current method of distributing GOES maps (2 million bytes per map) from three receiving locations (National Environmental Satellite Service) incurs large communications costs, the suitability of providing additional GOES antennas and receivers will be determined. Eventually, GOES data may be distributed through FAA's telecommunications network.

Products: GOES recorders at the AFSSs, the FAA Academy, and the FAA Technical Center.

Related Projects/Activities: FAA telecommunications network.

SCHEDULE



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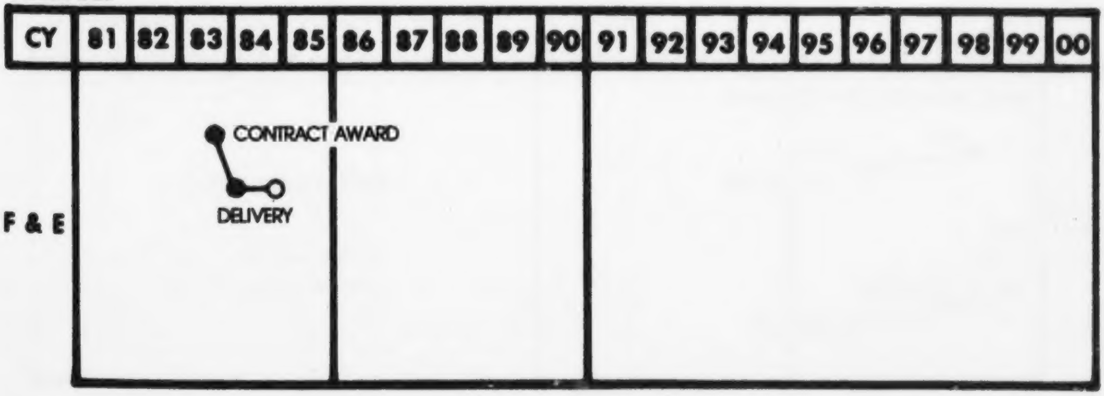
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PROJECT 12: Wind Shear Efforts

Purpose: This project will provide pilots with information on hazardous wind conditions (on or near airports) that create unsafe conditions for aircraft landings or departures.

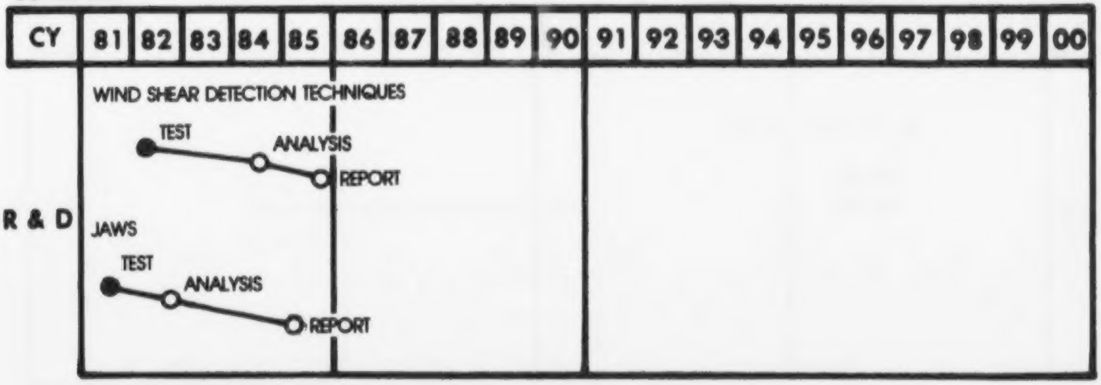
Approach: The FAA continues to seek solutions to problems associated with hazardous winds and their effect on aircraft. Efforts are divided into two categories, ongoing implementation programs for proven sensors and programs requiring continued research and development for improved sensors and predictors. Wind shear detection equipment is being implemented through an ongoing program for the low-level wind shear alert system (LLWAS). Since LLWAS is not the complete answer for detecting all wind shears, two avenues are being explored—enhancement of the LLWAS as new scientific information becomes available and continued research to assess the potential of Doppler radar and laser sensors to identify hazardous conditions. The joint airport weather studies (JAWS) program is a source of such research data.

- LLWAS. This is an ongoing program which, when completed, will provide 110 systems. There are 59 systems presently in operation. Fifty-one additional systems will be implemented from 1984-1986. The system consists of wind sensors located at center field and near the periphery of airports and a computer which processes sensor information and displays wind shear conditions to air traffic controllers for relay to pilots.

An enhanced LLWAS, consisting of ten remote units instead of five, will be installed in New Orleans. All the data will be recorded and analyzed to determine the benefits of increasing the number of sensors. A computer simulation model is also being developed to permit assessment of different algorithms using data gathered during the JAWS project and the New Orleans enhancement.

- JAWS. This joint effort among FAA, National Oceanic and Atmospheric Administration (NOAA), National Aeronautics and Space Administration (NASA), etc., utilized an array of Doppler radars, automated surface observations, radiosondes, lightning detection systems, and instrumented aircraft to detect and analyze weather hazards to aircraft. This data was gathered during 1981 and 1982 near Denver, Colorado. Hazards included wind shear, downbursts, microbursts, heavy rain, and thunderstorm-associated weather. Analysis of the data is continuing and is expected to provide information for inclusion in the NEXRAD specification. Data will also be used to assist in wind measuring systems siting criteria.

SCHEDULE



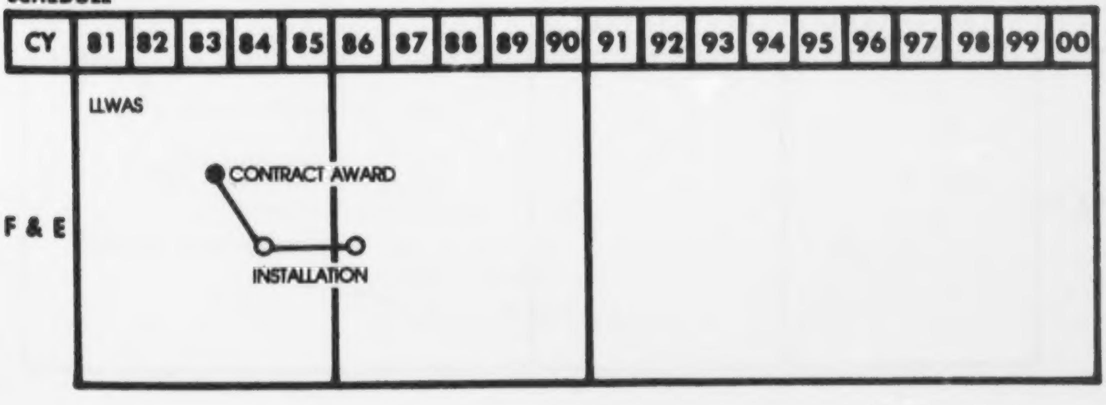
Products:

- Additional LLWASs (51) will be installed between 1984 and 1986.
- Wind shear models will be developed and a report published by 1985.
- The final report on JAWS will be available by early 1985.

Related Projects/Activities:

- NEXRAD and AWOS—the results of development efforts will be factored into the production specifications for these systems.

SCHEDULE



PROJECT 13: Integrated Communications Switching System (ICSS)

Purpose: This project will provide voice communications switching systems for new, replaced, or modernized ATCTs and TRACONs (previously provided with leased TELCO equipment), and for facilities which have obsolete equipment which can no longer be maintained. Also, it will provide systems for use at 61 automated FSSs.

Approach: Two phases of procurement are envisioned to provide ICSS for 1983-1987 and 1987-1992, respectively. In the first phase, competitive proposals were solicited for off-the-shelf systems, dividing the requirement into three types with increasing technical capabilities:

- Type 1 for ATCTs and TRACONs having up to 15 operator positions. Basic intercom, interphone, and radio communications capabilities were specified as an integrated system.

- Type 2 for TRACONs having 16-80 operator positions. All Type 1 requirements plus rapid automatic reconfiguration of pushbutton terminations, alphanumeric displays of the button functions, and traffic data collection were specified. Type 2 ICSSs will not be procured after 1992 when the TRACONs are consolidated into the ACFs. These are interim improvements to replace outmoded Western Electric Company 301 systems.

- Type 3 for automated FSSs. Type 2 requirements plus an automatic call distributor, call transfer, pilots automatic telephone weather answering service (PATWAS), fast file recorders, and a management information system display were specified. These systems will continue in use at all automated FSS facilities.

First-phase contracts for all three types were awarded in May 1982. Systems are being leased with an option to buy. If purchase is advantageous, the option will be exercised on a system-by-system basis. New systems may be ordered under the contract for 4 years, and deliveries will occur throughout that period as requirements are identified.

Planning for the second phase of ICSS procurement will begin at the beginning of CY-85 with contract award projected for the first quarter of CY-86.

Products:

- First phase:
  - —Approximately 130 Type 1 systems for small ATCT/TRACONs.
  - —20 Type 2 systems for larger TRACONs.
  - —61 Type 3 systems for AFSSs.
- Second phase:
  - —Approximately 100 Type 1 systems.
  - —10 Type 2 systems.

Related Projects/Activities: VSCS; Tower Communications System; Radio Control Equipment; ATCT/TRACON Establishment, Replacement, and Modernization.

This project appeared in the 1983 edition in Chapter V, Interfacility Communications Systems.

SCHEDULE

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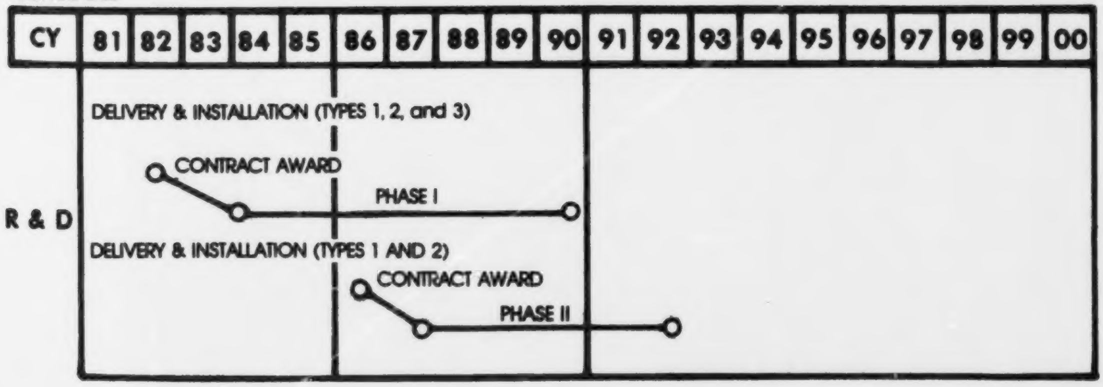
R & D																				

SCHEDULE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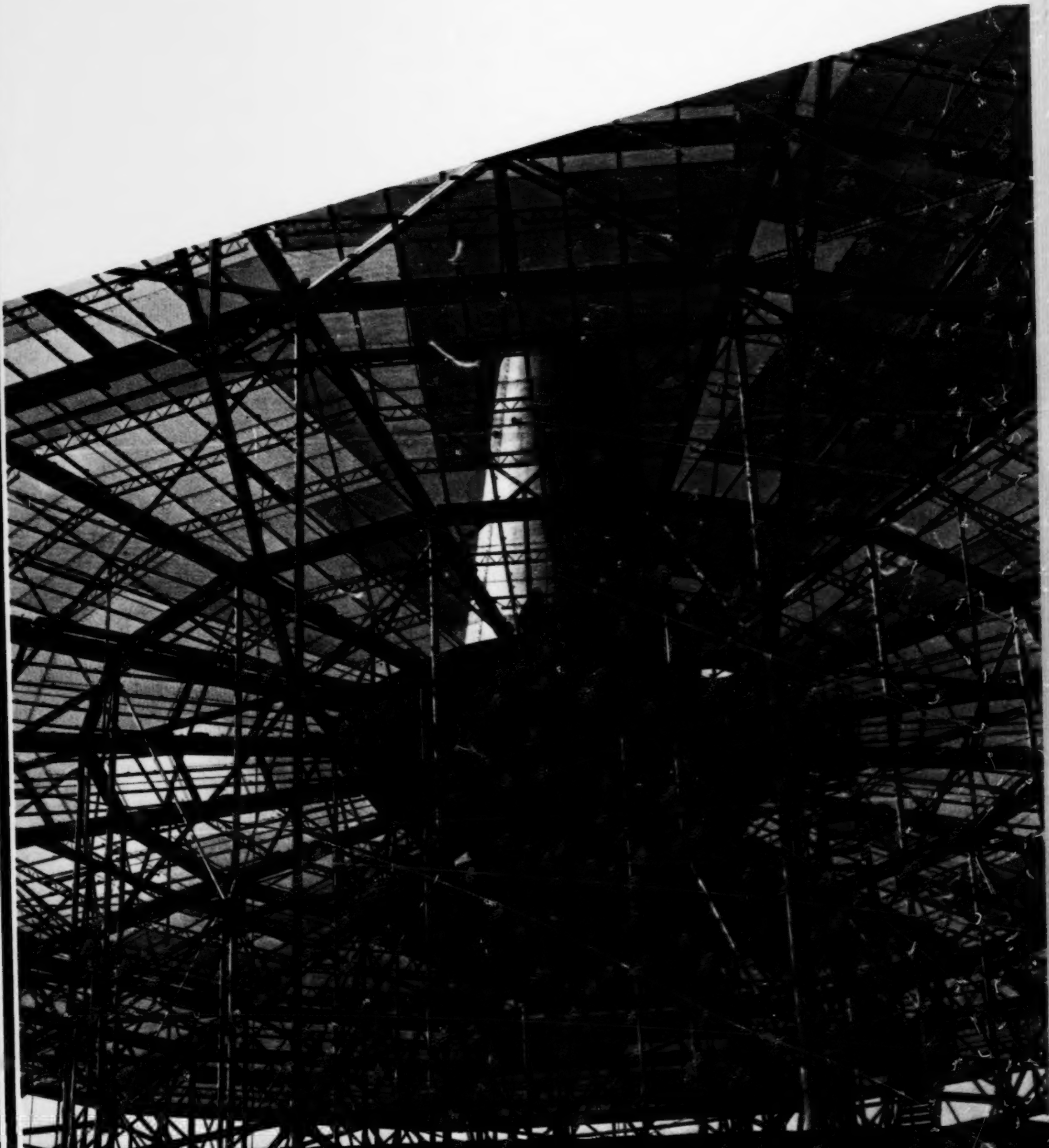
R & D
DELIVERY & INSTALLATION (TYPES 1, 2, and 3)
CONTRACT AWARD
PHASE I
DELIVERY & INSTALLATION (TYPES 1 AND 2)
CONTRACT AWARD
PHASE II

CHAPTER IV

GROUND-TO-AIR SYSTEMS



GROUND-TO-AIR SYSTEMS

The ground-to-air system comprises navigation, surveillance, and communications facilities. Navigational facilities provide guidance to aircraft. Surveillance and communications facilities are remote radar sensors and communication outlets for ARTCCs, ATCTs, TRACONs, and FSSs.

NAVIGATION

The present civil en route navigation system consists of VHF omnidirectional range (VOR), a radio station that provides point-to-point azimuth guidance. Distance information is obtained from distance measuring equipment (DME). Military aircraft use a UHF tactical air navigation (TACAN) system for azimuth and distance guidance. Air routes may be thought of as line segments connecting these various navigation facilities.

The disadvantage of air route navigation is the lack of flexibility in routing. Aircraft equipped with area navigation can select direct routes within coverage of the ground stations. However, area navigation is limited in the present system due to the cost of avionics and limitations of the air traffic system's ability to handle aircraft flying outside the route structure. The nondirectional beacon is a lower-cost, lower-capability alternative to the VOR station and is used where there is no VOR coverage. These beacons are used for en route guidance and fixes as well as being part of landing systems. The present navigation system primarily uses vacuum-tube technology, but parts are being replaced with solid-state equipment.

The present airport precision approach and landing system is the instrument landing system (ILS). A precision approach uses both azimuth and elevation guidance from a ground facility as well as marker beacons or DME and compass locators which enable equipped aircraft to fly by instruments along the approach path to the runway. There are still many vacuum tube-type ILSs in operation. Nonprecision approach with azimuth guidance only is available at many airports using the localizer portion of an ILS, VOR, or beacon. There are also approach aids at airports that are based on visual aids that use lights.

The direction finder (DF) is used to guide lost aircraft and for other emergencies. The aircraft's bearing is determined on the ground by using radio transmissions from the aircraft. The guidance information is then transmitted to the aircraft on a voice channel. The majority of the present DF systems are tube type and are located at flight service stations.

SURVEILLANCE

Surveillance of the airspace is currently provided by two types of radar: search radar and the radar beacon system, sometimes known as secondary radar. They are generally located at the same site. Search radar relies only on signals reflected from aircraft or from weather. The beacon system receives reply signals transmitted from airborne electronic equipment called transponders. On aircraft equipped with altitude encoders, the transponder automatically transmits the plane's altitude. The beacon system is presently the main source of surveillance information used for air traffic control. Search radar supplements beacon and gives weather information.

There are two types of search radars. The en route system consists exclusively of long-range radar while the terminal system uses shorter range airport radars. Both radars are used extensively for flight monitoring. Because search radar was designed for aircraft surveillance, it is presently capable of giving only limited information on weather and precipitation. Another type of radar, airport surface detection equipment, is used by tower controllers to detect aircraft and vehicles on runways and taxiways during low-visibility conditions.

COMMUNICATIONS

Ground-to-air communications facilities provide voice radio communications between air traffic control facilities and aircraft. This is the method of communicating between controllers and pilots in both en route and terminal airspace. Other ground-to-air facilities provide communication between aircraft and flight service station specialists who keep in radio contact with pilots regarding their flight plan, weather, and en route advisories.

The en route facilities communicate with aircraft using remote ground-to-air communications stations located to give coverage for each air traffic control sector. The modernization of these facilities to replace vacuum-tube transmitter-receiver equipment is nearly complete. However, the present signaling and control equipment is obsolete, making it costly to maintain. The terminal area facilities also use remote transmitter-receiver stations for ground-to-air communications. The majority of them are still vacuum tube-type, and their signaling and control equipment is obsolete. The ground-to-air communication equipment at flight service stations is also obsolete since few of them are solid state.

THE NEW APPROACH

Major improvements will upgrade ground-to-air systems to solid state; provide remote maintenance monitoring; and consolidate the location of navigation, surveillance, and communications facilities. New and more capable systems will be placed into operation, such as Mode S with data link, the microwave landing system (MLS), and a new generation of weather radars.

To develop a nationwide system of navigation, surveillance, and communications, as well as weather radar coverage, a networking concept will be used. These networks will result in significant cost savings by reducing the number of systems and facilities, yet, assuring required coverage. Due to line-of-sight transmissions and the earth's curvature, systems provide coverage at lower altitudes the closer an aircraft is to a facility. Ultimately, as traffic requires, surveillance and Mode S radar coverage will be 6,000 feet altitude above mean sea level or the minimum en route altitude, whichever is higher. Weather radar coverage will be provided above 10,000 feet and down to the surface at selected airports. En route navigation and communication coverages will be available above 2,000 feet above the terrain except where there is little air traffic. Direction finder coverage will be expanded as required, emphasizing those areas below radar coverage.

HOW THE SYSTEM WILL EVOLVE

NEAR TERM (TO 1985)

Most of the navigation and communications improvements will focus on replacing obsolete vacuum-tube equipment with solid-state technology. Remote maintenance monitoring will almost be completed in the VOR/DME and VORTAC navigation stations.

To meet essential requirements, a limited number of new ILS facilities will be installed through 1984; but, substantial numbers of tube-type ILS components will be upgraded with solid-state equipment. The installation of microwave landing systems will be started. Research and development for several future systems will be underway.

Many visual approach slope indicators, runway approach lighting systems, and runway-end indicator lights will be installed. Additional DMEs will be added to ILS facilities. Additional DF facilities will be established.

INTERMEDIATE TERM (TO 1990)

Radar networking will be underway to provide surveillance coverage down to 6,000 feet mean sea level and to the surface at qualifying airports as traffic requires. The number of existing military radars providing information to FAA air traffic control will be expanded. The establishment of a new high-performance, low-maintenance, 3-dimensional, long-range radar will be nearly completed. Establishment of this radar will enable relocation of some ARSR 3's to areas requiring coverage. When completed, the network will include en route and terminal search radars and radar beacon systems. Establishment of a new terminal radar with a weather channel will be nearly completed. Department of Defense requirements will be met or exceeded by using the national perimeter of minimally attended radars. To complete networking, conversion to all digital remoting of en route surveillance, terminal surveillance, and weather radar data will be required. Development for this digital remoting will be completed.

En route search radar will be retained for FAA weather and air traffic control requirements until the next generation of weather radar becomes operational and other agency requirements are met.

With Mode S, each aircraft can be interrogated individually. Mode S and data link coverage will be provided by 1991 above an altitude of 12,500 feet mean sea level and down to the surface at qualifying airports. The 1991 network will consist of 137 systems. Mode S will enhance surveillance accuracy and reliability. This will improve separation assurance and air traffic efficiency. Aviation weather will be given automatically to pilots by data link on request and will include significant meteorological reports. Mode S/data link will also provide the medium for future ATC clearance transmission to pilots in the cockpit.

En route navigation coverage will be provided by VOR/DME down to 2,000 feet above the terrain except where there is little air traffic. Existing VOR/DME and VORTACs will have been upgraded. VOR networking will keep the number of these facilities constant until the year 2000. If new coverage is needed, existing facilities with overlapping coverage will be relocated. With increased use of area navigation, the number of VOR/DME stations may be reduced. TACAN will be discontinued if the Department of Defense places its global positioning system satellite navigation system into operation and their aircraft are equipped with proper receivers. Serious consideration is being given to removing most VORTAC standby engine generators to reduce fuel and operations costs. As a result, in case of power failure, VOR/DMEs would operate on battery backup. In this instance, a TACAN located at the same site would not be able to operate since its antenna drive motors require excessive electrical power.

The direction finder sensor network expansion will be completed to assist lost aircraft or in emergency situations where avionic systems have failed. Remote maintenance monitoring will have been added. Nondirectional homing beacons will be added in limited numbers when there is a new navigation requirement for them. A small number of critical vacuum-tube instrument landing systems components, not replaced by 1985, will be replaced with solid-state components. Microwave landing systems will continue to be established. The number of ILSs will remain relatively constant while new qualifiers will receive MLSs.

Many visual approach slope indicators, runway approach lighting systems, and runway-end indicator lights will be installed by the FAA. All new installations will be taken over by the airport owners.

En route voice communication coverage for ACFs and flight service stations will be provided down to 2,000 feet above the terrain except where there is very little air traffic. Voice communications for towers will continue to be provided to the surface. Because of frequency requirements, conversion of ground and airborne systems to 25-kHz channel spacing will be required. Consolidation of identical communications equipment into common buildings or with other compatible facilities will provide significant operations cost savings. Remote communications systems will also be located at the same site with VOR/DME stations and en route surveillance facilities.

As a result, the number of independent communication facilities, buildings, and property leases can be reduced substantially. Buildings and related equipment will be improved to meet consolidation and new system requirements.

Until NEXRAD, the joint service Doppler weather radar, is fully operational, aviation weather will be provided from FAA search radar used for air traffic control. Weather radar advisories will be provided by a mix of FAA and National Weather Service systems.

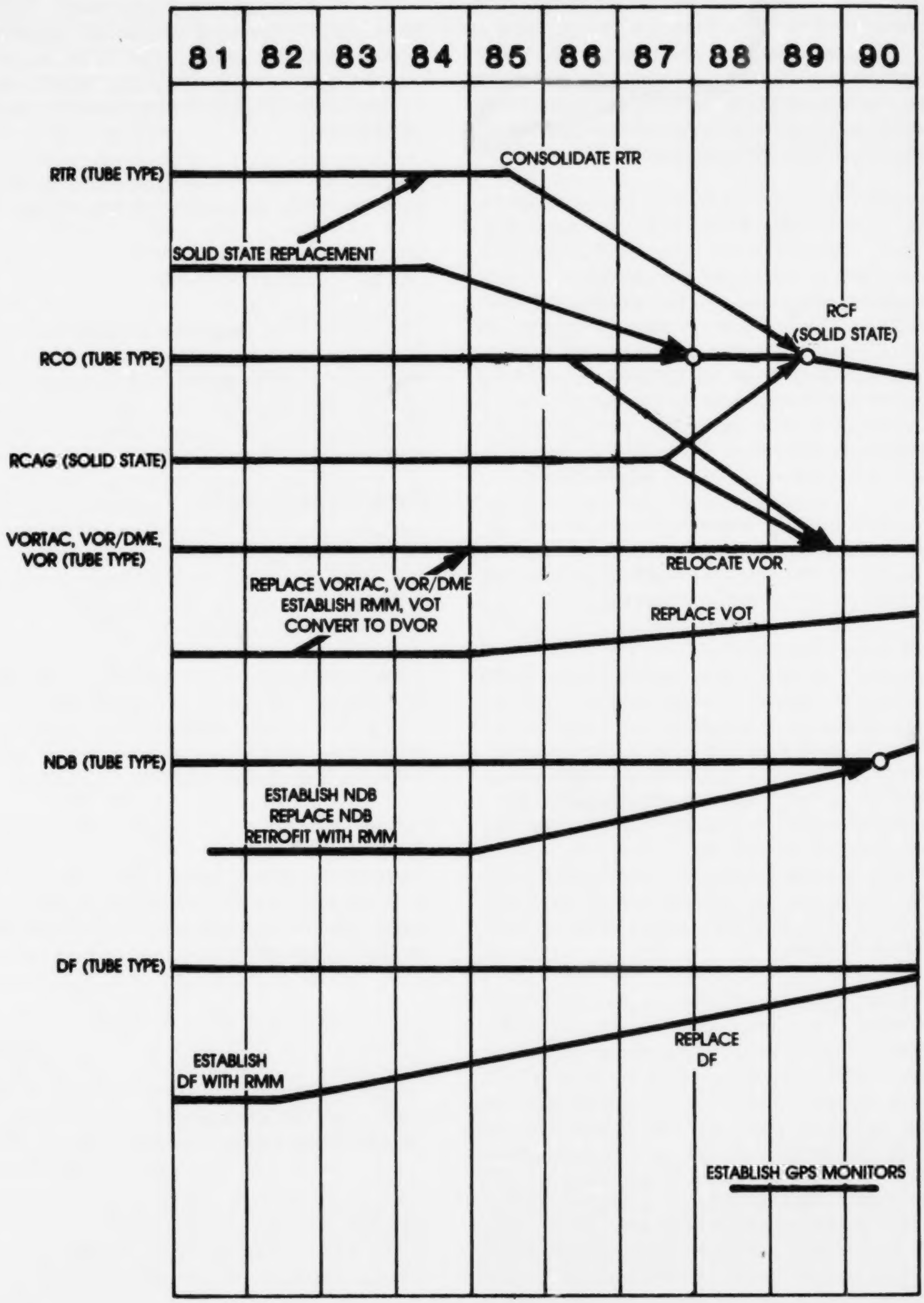
The existing 12 vacuum-tube airport surface detection equipment radars will be replaced with solid-state systems, and 17 new systems will be established. This system enables controllers in the tower to monitor the position of aircraft and airport vehicles on runways and taxiways in all types of weather.

LONG TERM (TO 2000)

Radar networking will be completed. Data link coverage will be extended from 12,500 feet altitude down to 6,000 feet above mean sea level, giving weather and air traffic services to lower flying aircraft.

In designated airspace, it is anticipated that aircraft will be equipped with Mode S to derive the benefits of automated services. Weather radar information will be improved as the FAA weather network (including NEXRAD) becomes operational.

FAA en route search radar may be decommissioned if all planes are transponder equipped while operating above 6,000 feet and required FAA weather radar information is obtained from NEXRAD weather radar facilities. The following diagram and maps describe the evolution of the system.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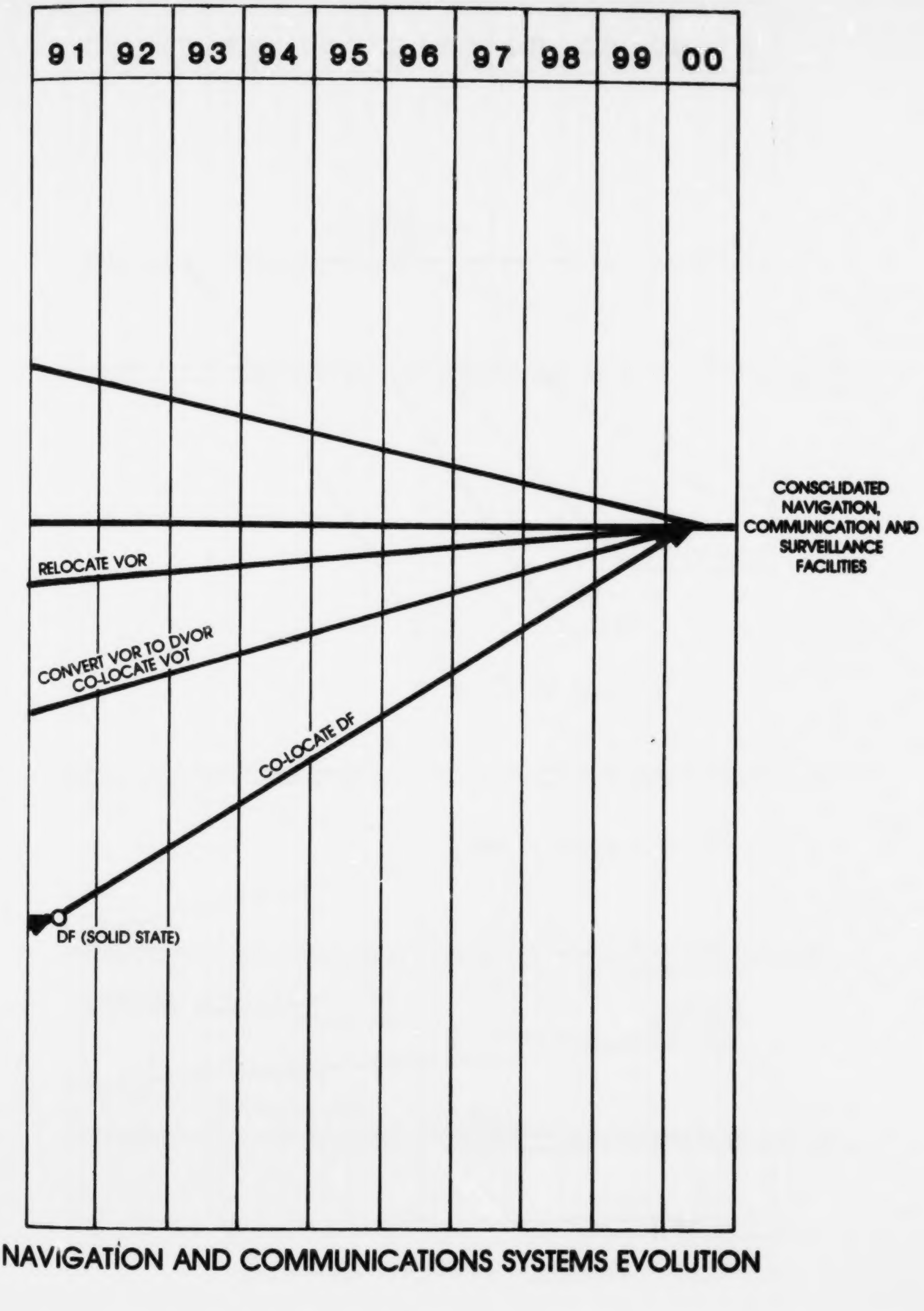
RTR (TUBE TYPE)
CONSOLIDATE RTR
SOLID STATE REPLACEMENT
RCF
(SOLID STATE)
RCO (TUBE TYPE)
RCAG (SOLID STATE)
VORTAC, VOR/DME,
VOR (TUBE TYPE)
RELOCATE VOR
REPLACE VORTAC, VOR/DME
ESTABLISH RMM, VOT
CONVERT TO DVOR
REPLACE VOT
NDB (TUBE TYPE)
ESTABLISH NDB
REPLACE NDB
RETROFIT WITH RMM
DF (TUBE TYPE)
REPLACE
DF
ESTABLISH
DF WITH RMM
ESTABLISH GPS MONITORS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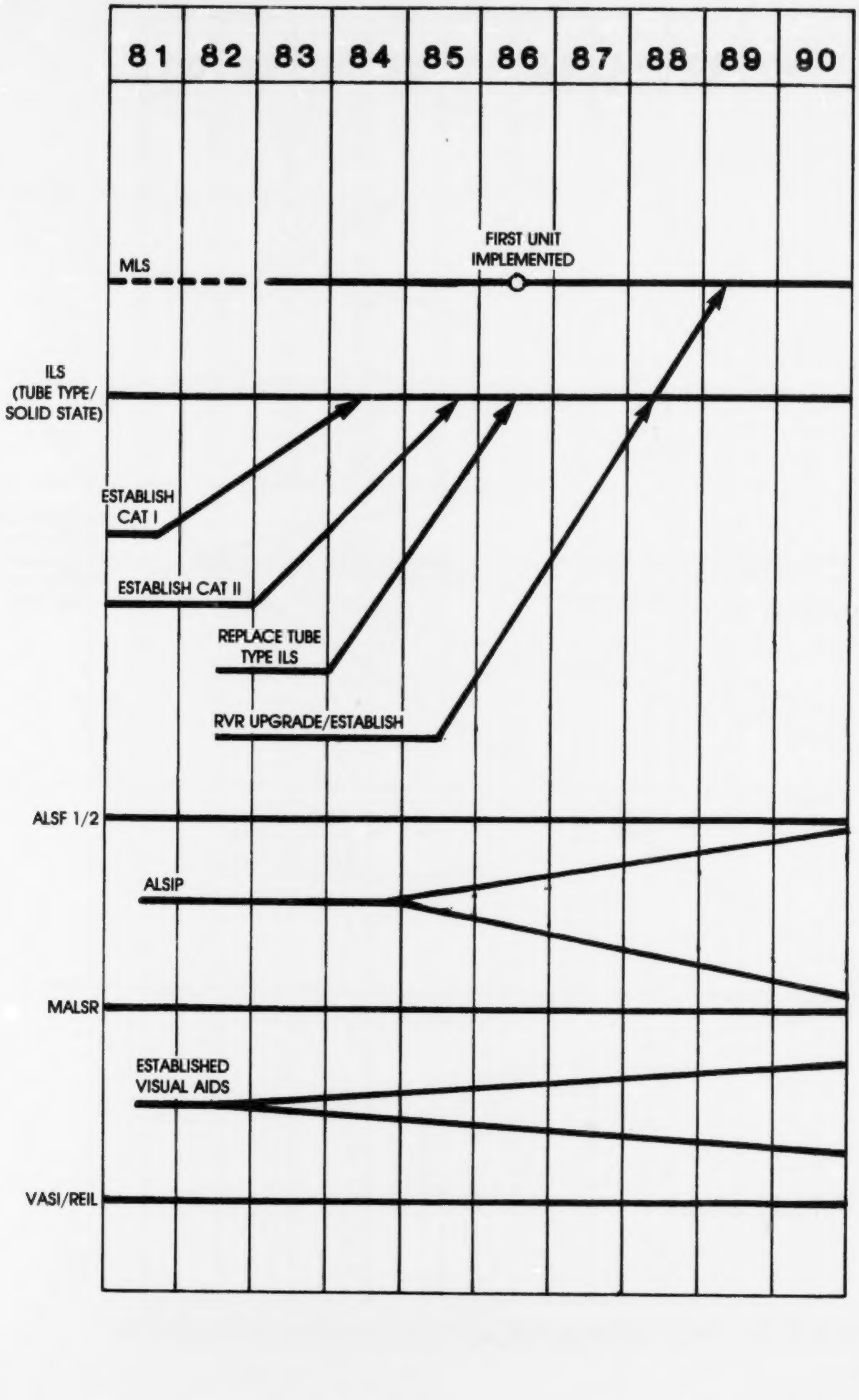
RELOCATE VOR
CONVERT VOR TO DVOR
CO-LOCATE VOT
CO-LOCATE DF
DF (SOLID STATE)
CONSOLIDATED
NAVIGATION,
COMMUNICATION AND
SURVEILLANCE
FACILITIES

NAVIGATION AND COMMUNICATIONS SYSTEMS EVOLUTION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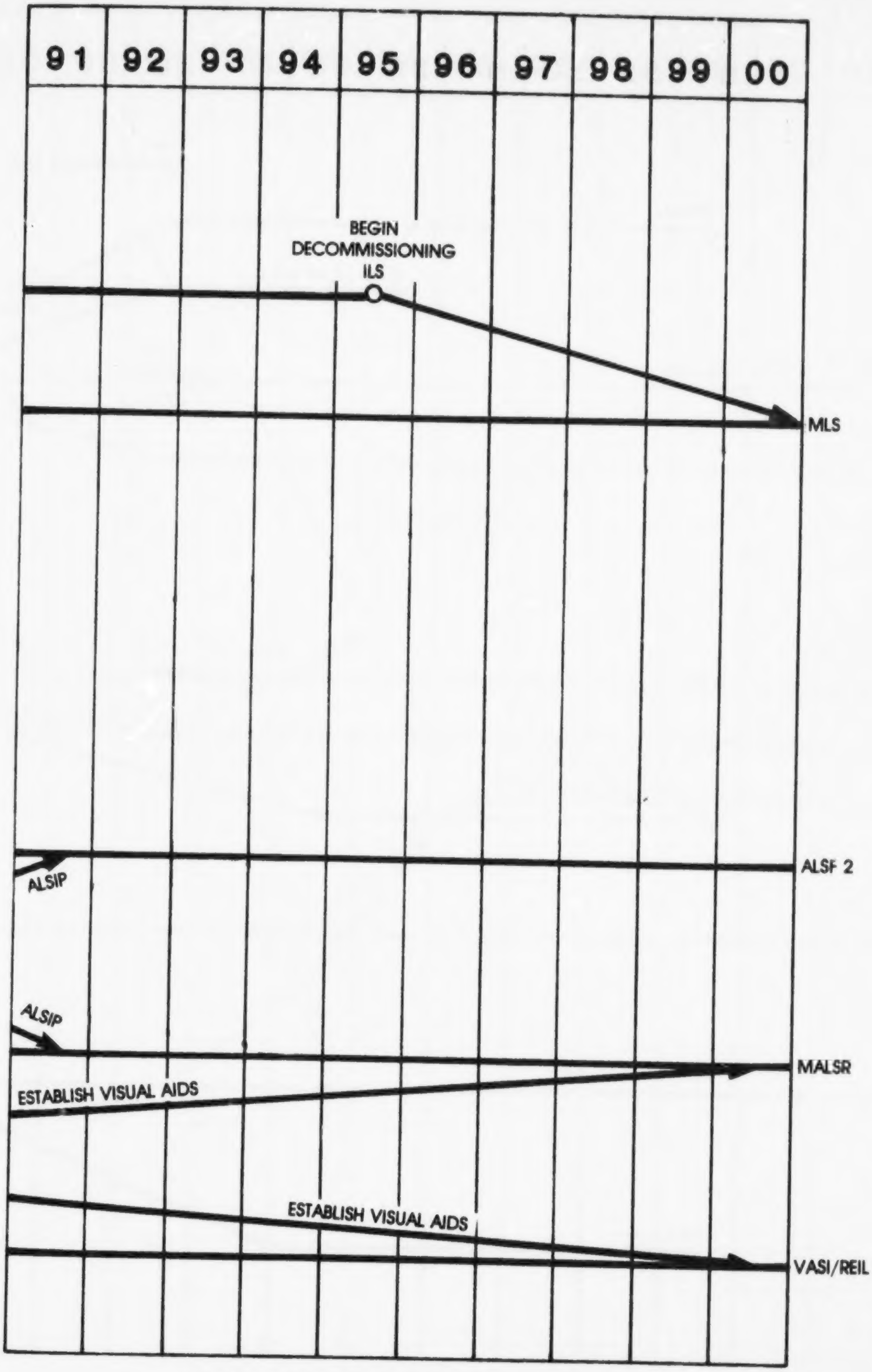
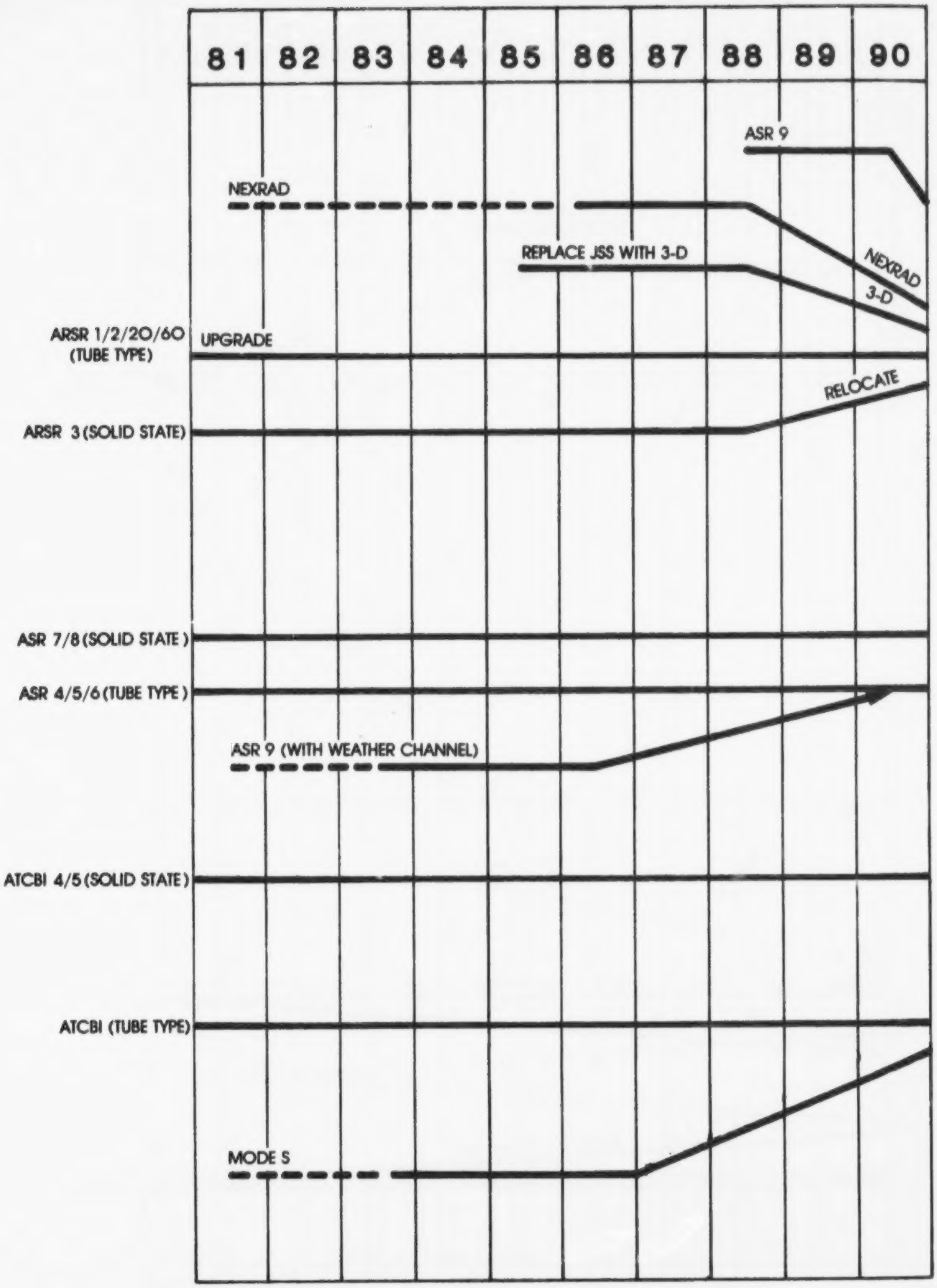
MLS
FIRST UNIT IMPLEMENTED
ILS (TUBE TYPE/ SOLID STATE)
ESTABLISH CAT I
ESTABLISH CAT II
REPLACE TUBE TYPE ILS
RVR UPGRADE/ESTABLISH
ALSF 1/2
ALSIP
MALSR
ESTABLISHED VISUAL AIDS
VASI/REIL



LANDING SYSTEMS EVOLUTION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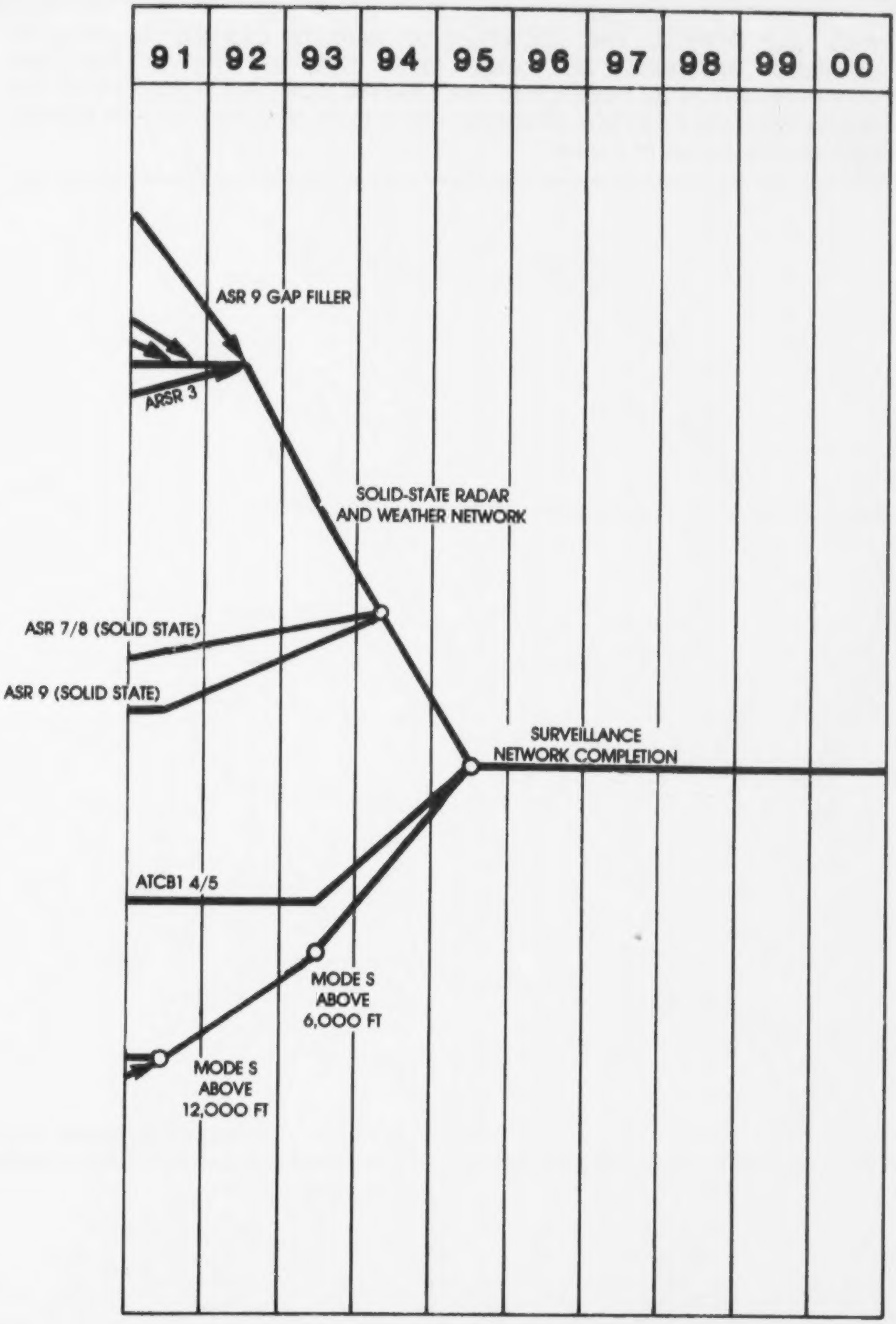
ASR 9
NEXRAD
REPLACE JSS WITH 3-D
NEXRAD
3-D
ARSR 1/2/20/60 (TUBE TYPE)
UPGRADE
RELOCATE
ARSR 3 (SOLID STATE)
ASR 7/8 (SOLID STATE)
ASR 4/5/6 (TUBE TYPE)
ASR 9 (WITH WEATHER CHANNEL)
ATCBI 4/5 (SOLID STATE)
ATCBI (TUBE TYPE)
MODE S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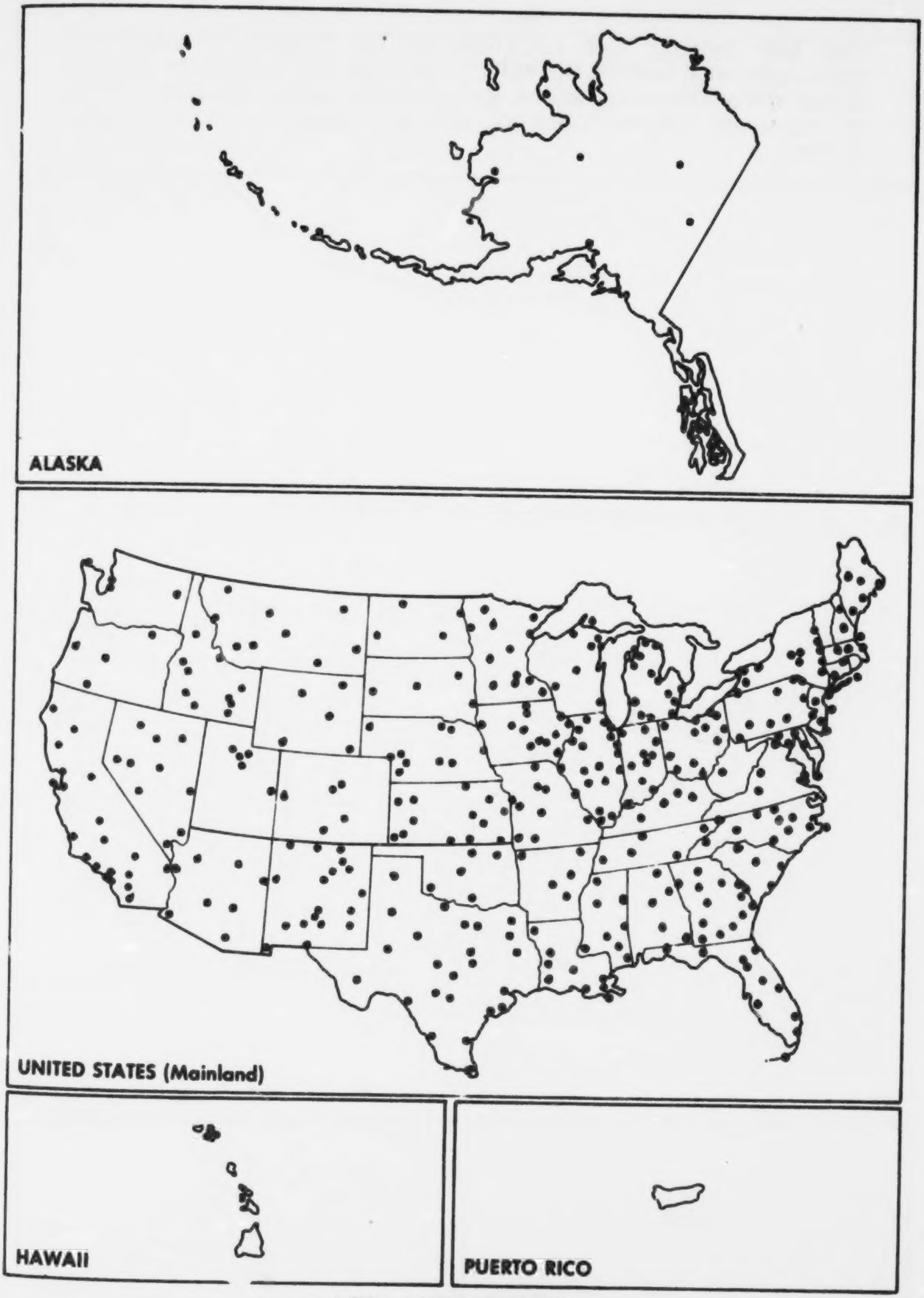
ASR 9 GAP FILLER
ARSR 3
SOLID-STATE RADAR AND WEATHER NETWORK
ASR 7/8 (SOLID STATE)
ASR 9 (SOLID STATE)
SURVEILLANCE NETWORK COMPLETION
ATCBI 4/5
MODE S ABOVE 6,000 FT
MODE S ABOVE 12,000 FT

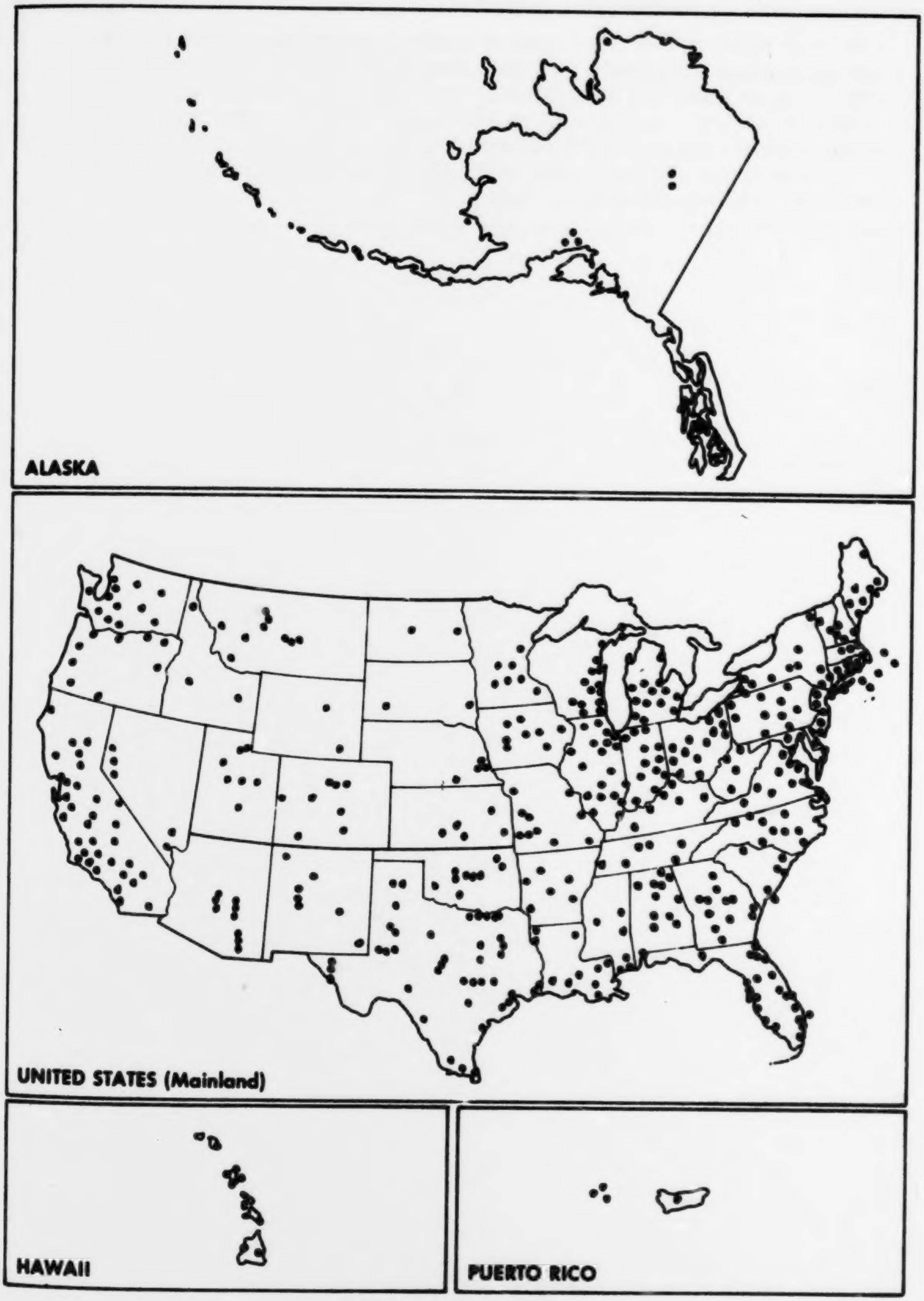
SURVEILLANCE SYSTEMS EVOLUTION

THIS MAP DEPICTS THE LOCATION OF REMOTE CENTER AIR/GROUND SYSTEMS BETWEEN 1981 AND 1990. THE 550 RCAGs PROVIDE COMMUNICATION BETWEEN THE AIR TRAFFIC CONTROLLERS AT THE AIR ROUTE TRAFFIC CONTROL CENTERS AND THE PILOTS. NOT SHOWN ON THE MAP IS ONE RCAG IN GUAM.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

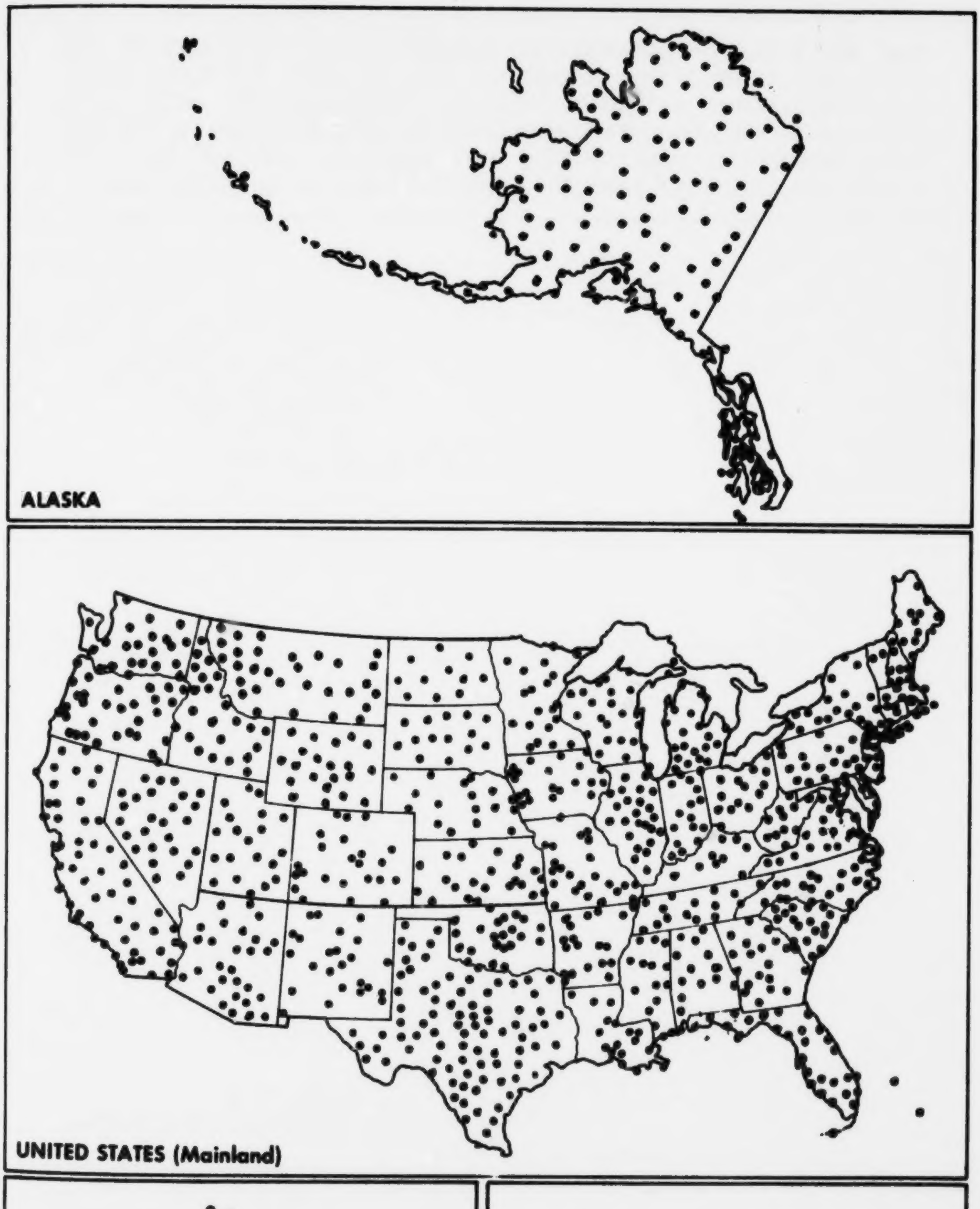
1981-1990 SYSTEM
EN ROUTE COMMUNICATIONS

THIS MAP DEPICTS THE LOCATION OF 733 REMOTE TRANSMITTER RECEIVERS (RTR) DURING THE PERIOD 1981-1990. NOT SHOWN ON THE MAP IS ONE RTR IN AMERICAN SAMOA. RTRs PROVIDE RADIO COMMUNICATIONS BETWEEN AIR TRAFFIC CONTROLLERS AT TERMINAL FACILITIES AND PILOTS.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

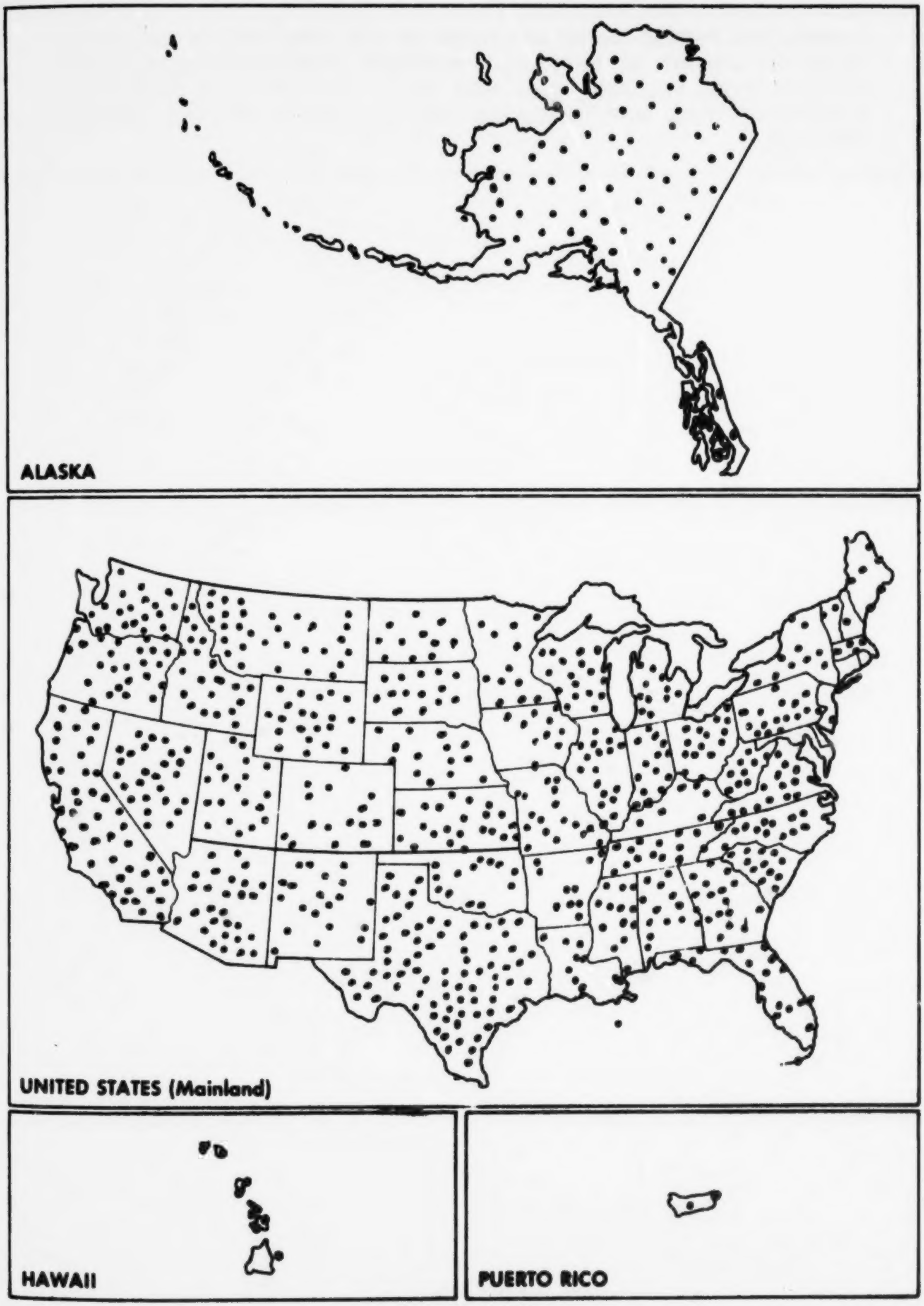
1981-1990 SYSTEM
TERMINAL COMMUNICATIONS

THIS MAP DEPICTS THE LOCATION OF REMOTE COMMUNICATIONS OUTLETS (RCOs) DURING THE PERIOD 1981-1985. THIS MAP DEPICTS THE LOCATION OF 773 RCOs IN 1985. OF THIS TOTAL, 600 ARE CO-LOCATED WITH VORs/VORTACs AND 173 ARE STAND-ALONE SITES. THE RCO PROVIDES RADIO COMMUNICATIONS SERVICES BETWEEN FLIGHT ADVISORY SPECIALISTS AT FLIGHT SERVICE STATIONS AND AIRCRAFT PILOTS, AIRBORNE OR ON THE GROUND, WAITING FOR FLIGHT DATA.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

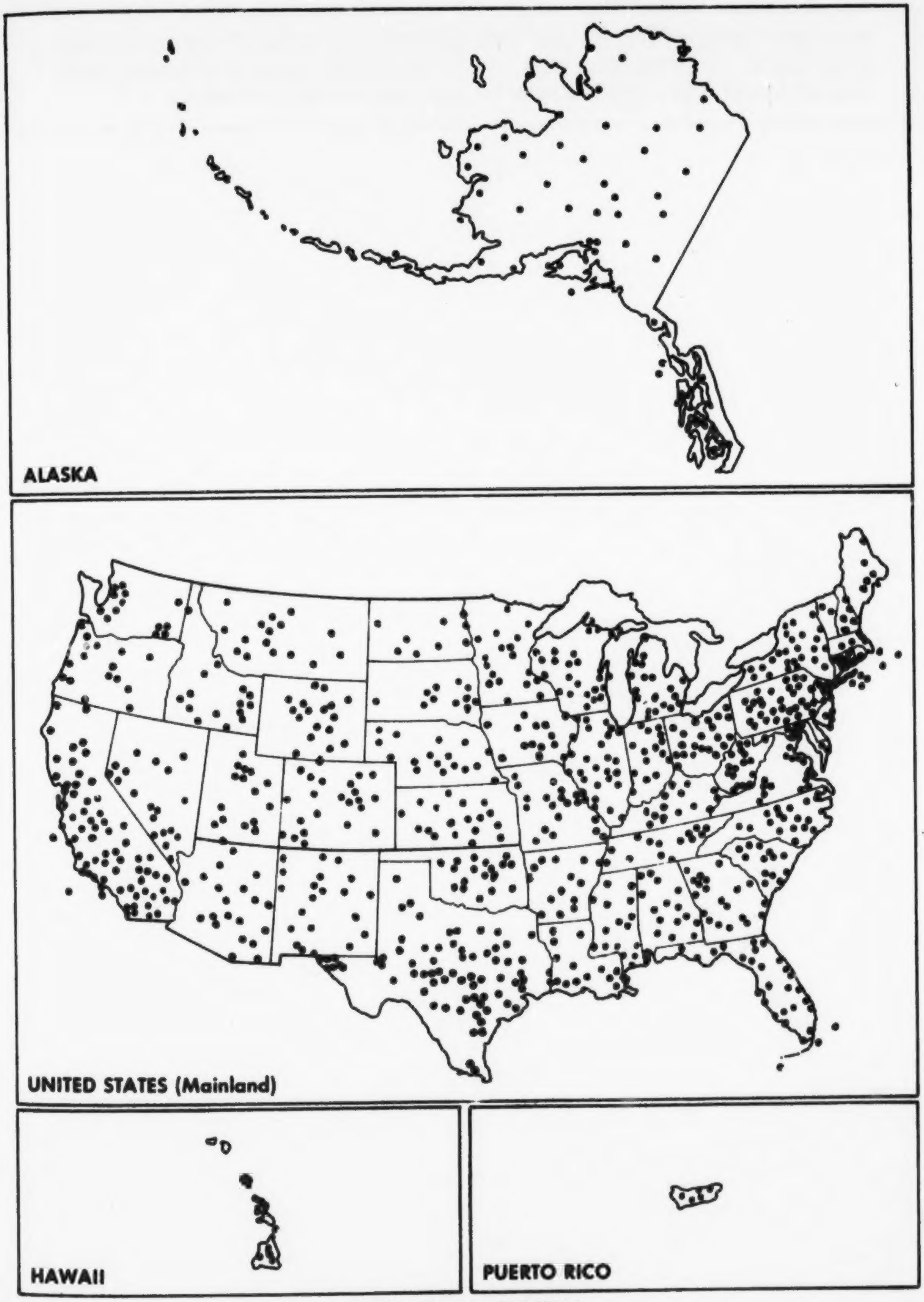
1981-1985 SYSTEM
FLIGHT SERVICE COMMUNICATIONS

THIS MAP DEPICTS CONSOLIDATED COMMUNICATIONS SYSTEMS BY THE YEAR 2000. DURING THE PERIOD OF 1985 TO 2000, THE 2,513 TOTAL COMMUNICATIONS SYSTEMS WILL BE CONSOLIDATED INTO 1,118 COMMUNICATIONS FACILITIES PROVIDING SERVICE BETWEEN PILOTS AND FSSs, TERMINALS, AND ARTCCs. NOT DEPICTED ON THE MAP ARE ADDITIONAL FACILITIES IN REMOTE ISLANDS SUCH AS AMERICAN SAMOA.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

2000 SYSTEM
AIR/GROUND COMMUNICATIONS

DURING THIS PERIOD THERE ARE OVER 950 VHF OMNIDIRECTIONAL RANGE (VOR) EQUIPMENT IN SEVERAL DIFFERENT CONFIGURATIONS. THESE INCLUDE VOR, VOR/DME, AND VOR WITH TACTICAL AIR NAVIGATION EQUIPMENT. THIS MAP INDICATES THE LOCATIONS OF THE EXISTING SYSTEMS.



ALASKA

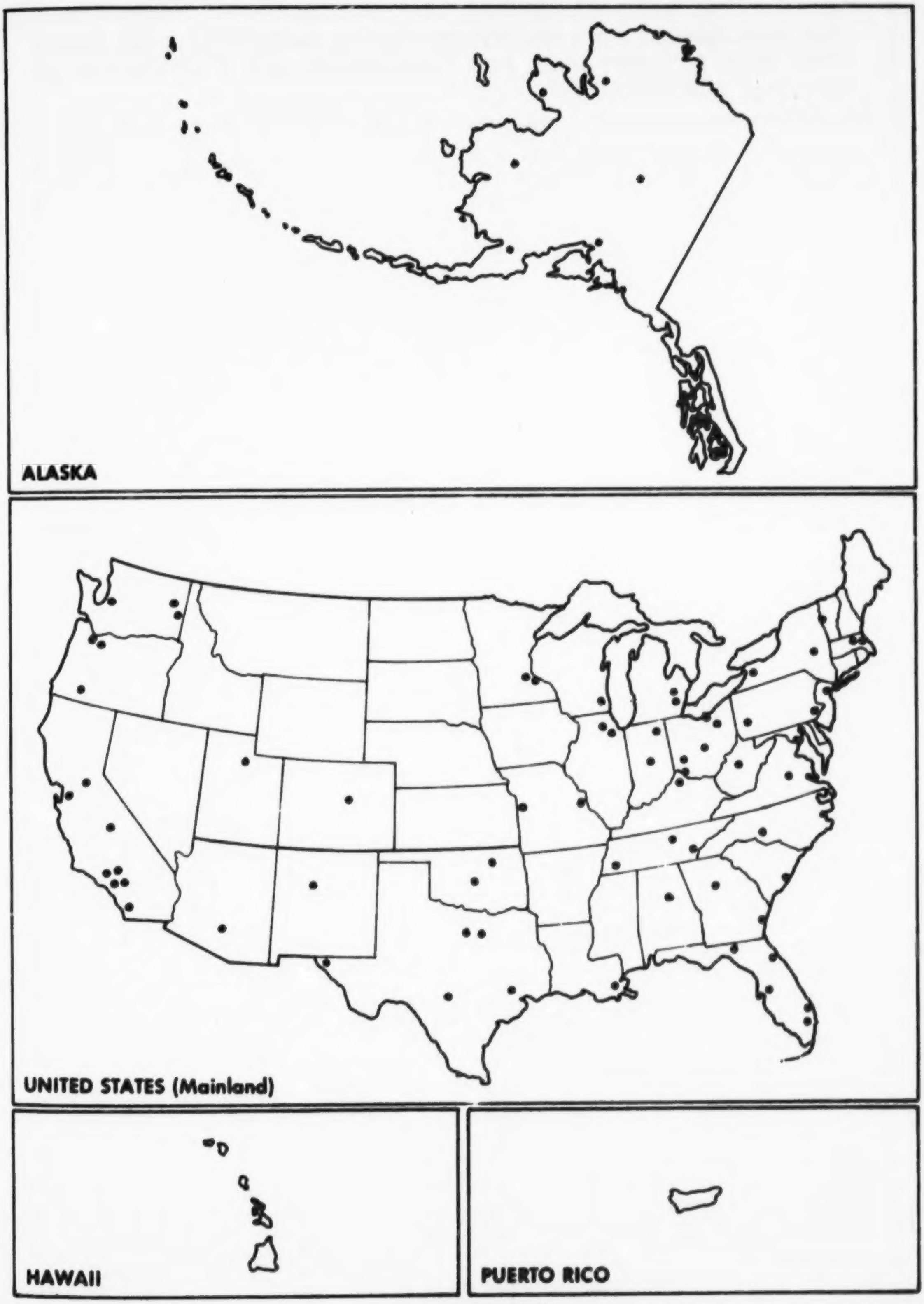
UNITED STATES (Mainland)

HAWAII

PUERTO RICO

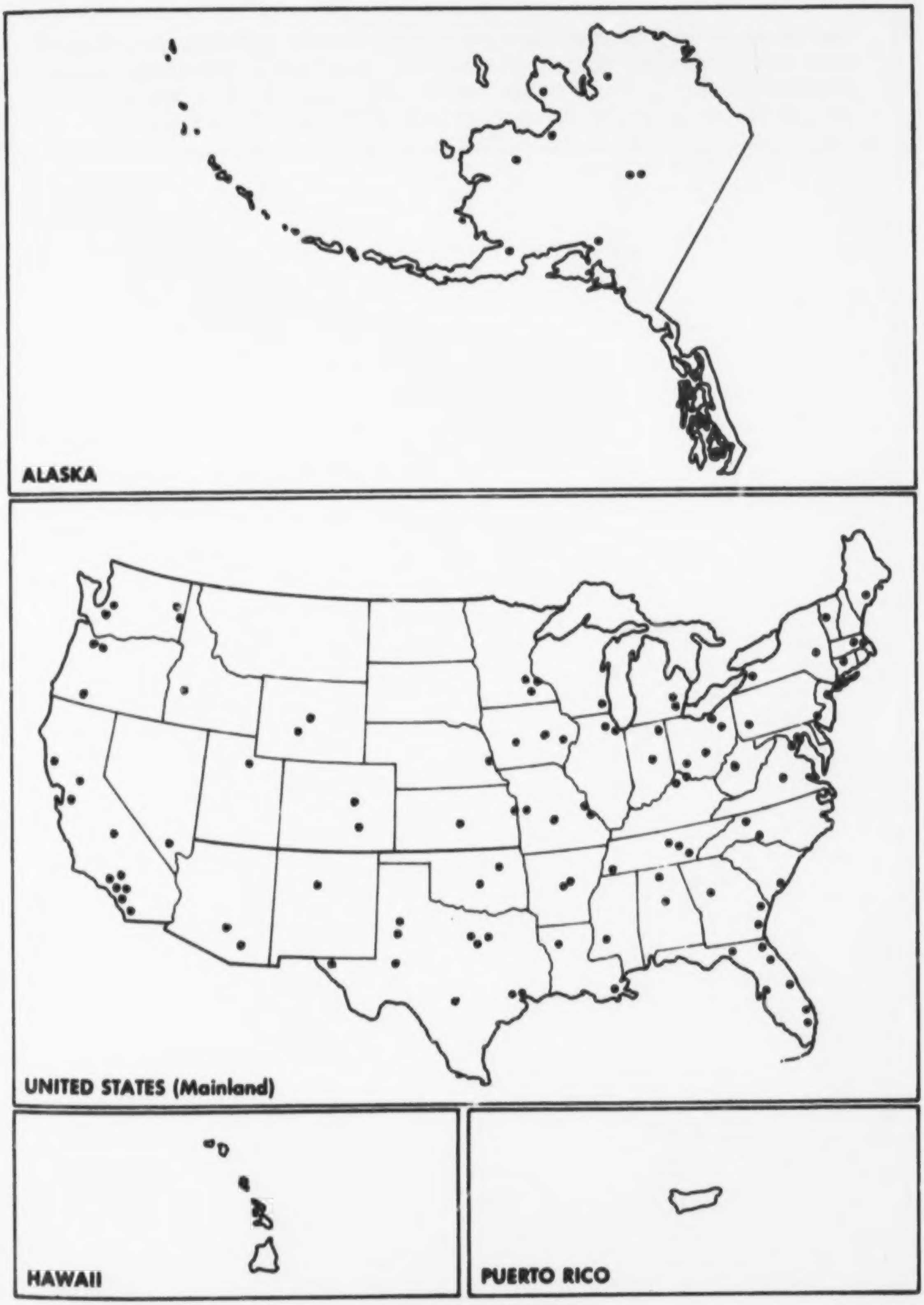
1981-2000 SYSTEM
VHF OMNIDIRECTIONAL RANGE

THIS MAP DEPICTS THE 77 VHF OMNIDIRECTIONAL RANGE TEST SYSTEMS EXISTING AT THE PRESENT TIME. THESE SYSTEMS PROVIDE A SIGNAL FOR CALIBRATION AND VERIFICATION OF AIRCRAFT VOR EQUIPMENT.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

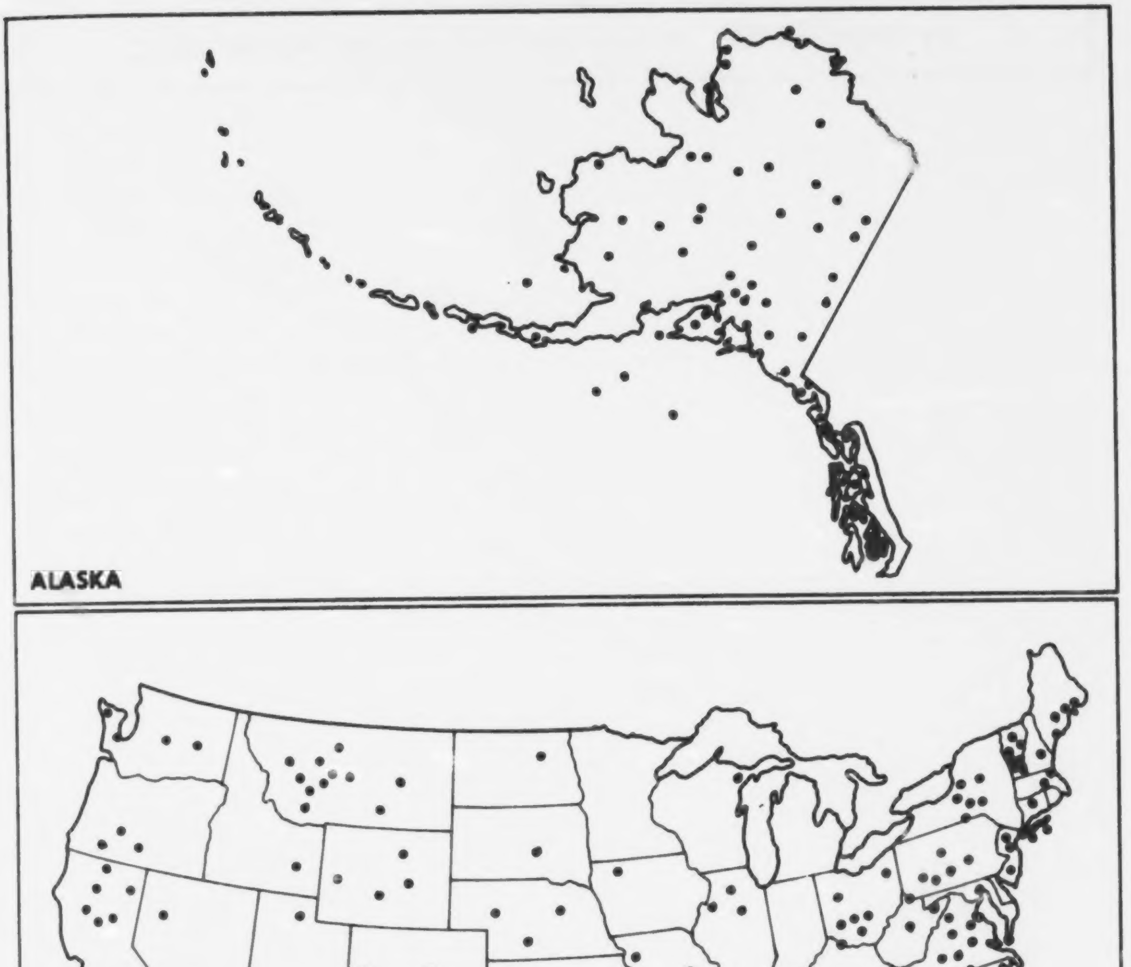
1981 SYSTEM
VHF OMNIDIRECTIONAL RANGE TEST

THIS MAP DEPICTS THE LOCATION OF 112 VHF OMNIDIRECTIONAL RANGE TEST (VOT) SYSTEMS USED FOR CALIBRATION AND VERIFICATION OF AIRCRAFT VOR EQUIPMENT.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1985-2000 SYSTEM
VHF OMNIDIRECTIONAL RANGE TEST

THERE WERE 215 OPERATIONAL NONDIRECTIONAL BEACON SYSTEMS IN 1981 USED FOR EN ROUTE NAVIGATION AND FIXES. NONDIRECTIONAL BEACONS USED AS PART OF AN INSTRUMENT LANDING SYSTEM (ILS) ARE INCLUDED ON ILS MAPS. BY 1990, 20 NEW SYSTEMS WILL BE ADDED.


ALASKA

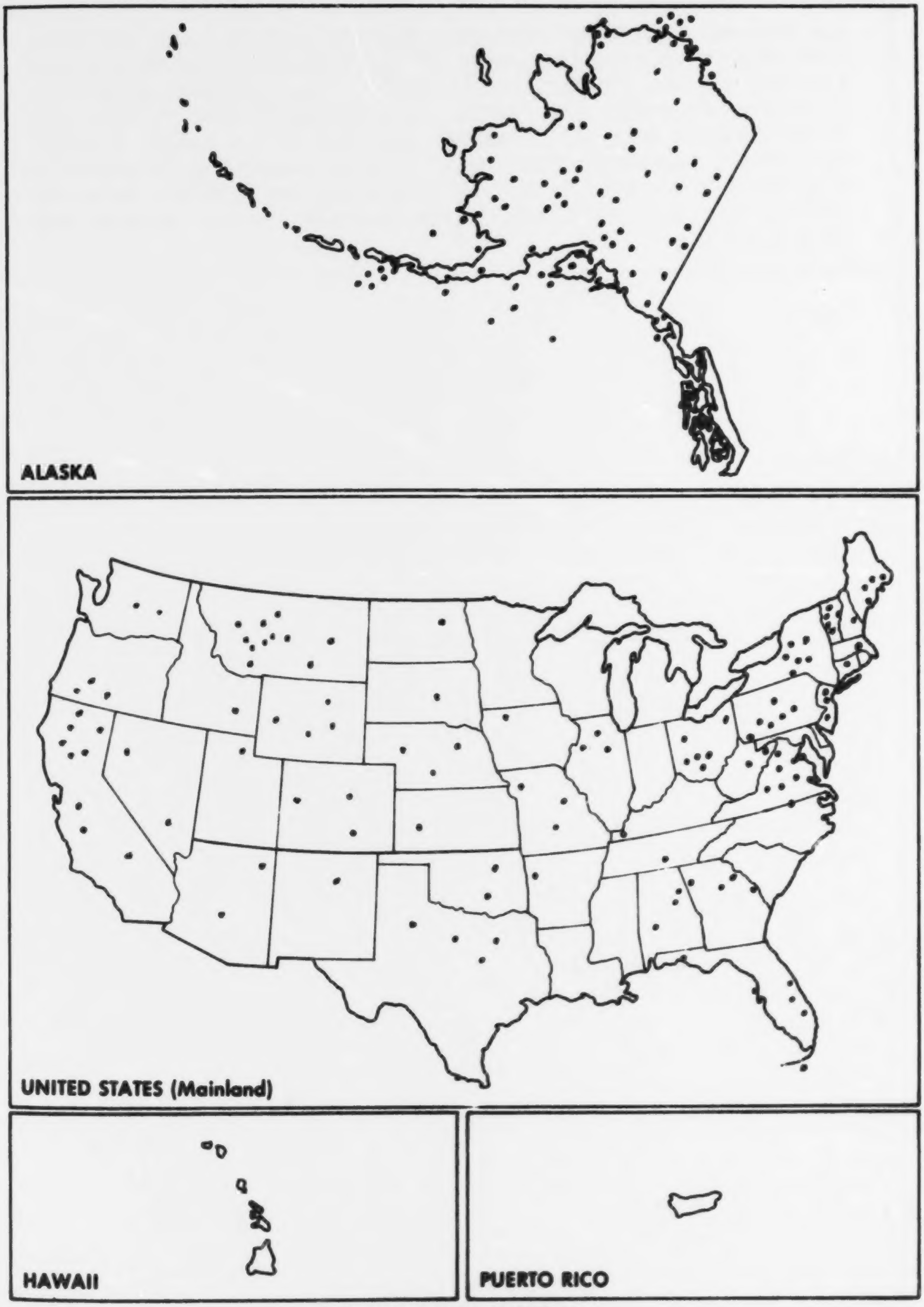
UNITED STATES (Mainland)

HAWAII

PUERTO RICO

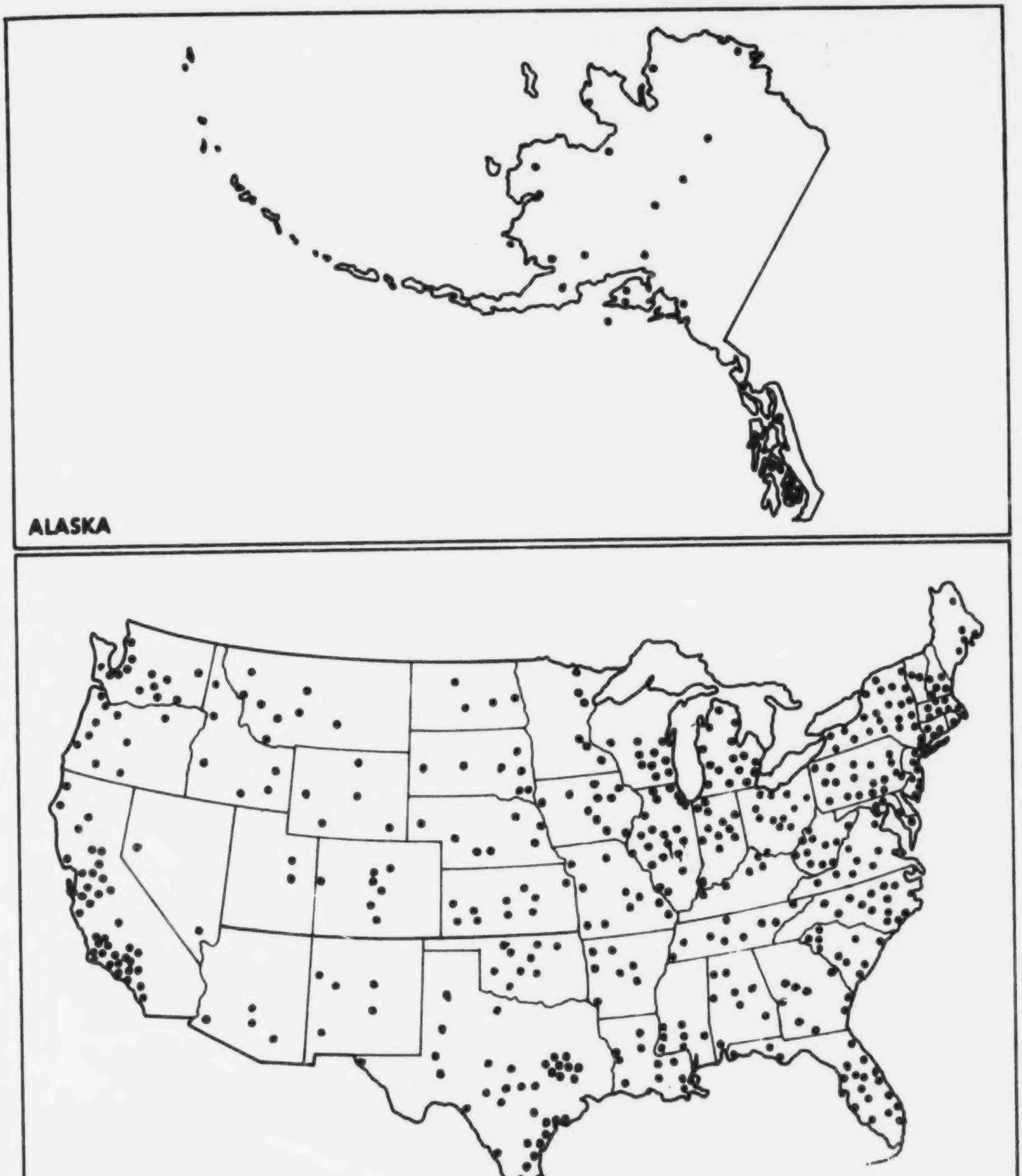
1981-1990 SYSTEM
NONDIRECTIONAL BEACON

BY THE YEAR 2000, 48 NEW SYSTEMS WILL BE OPERATIONAL.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

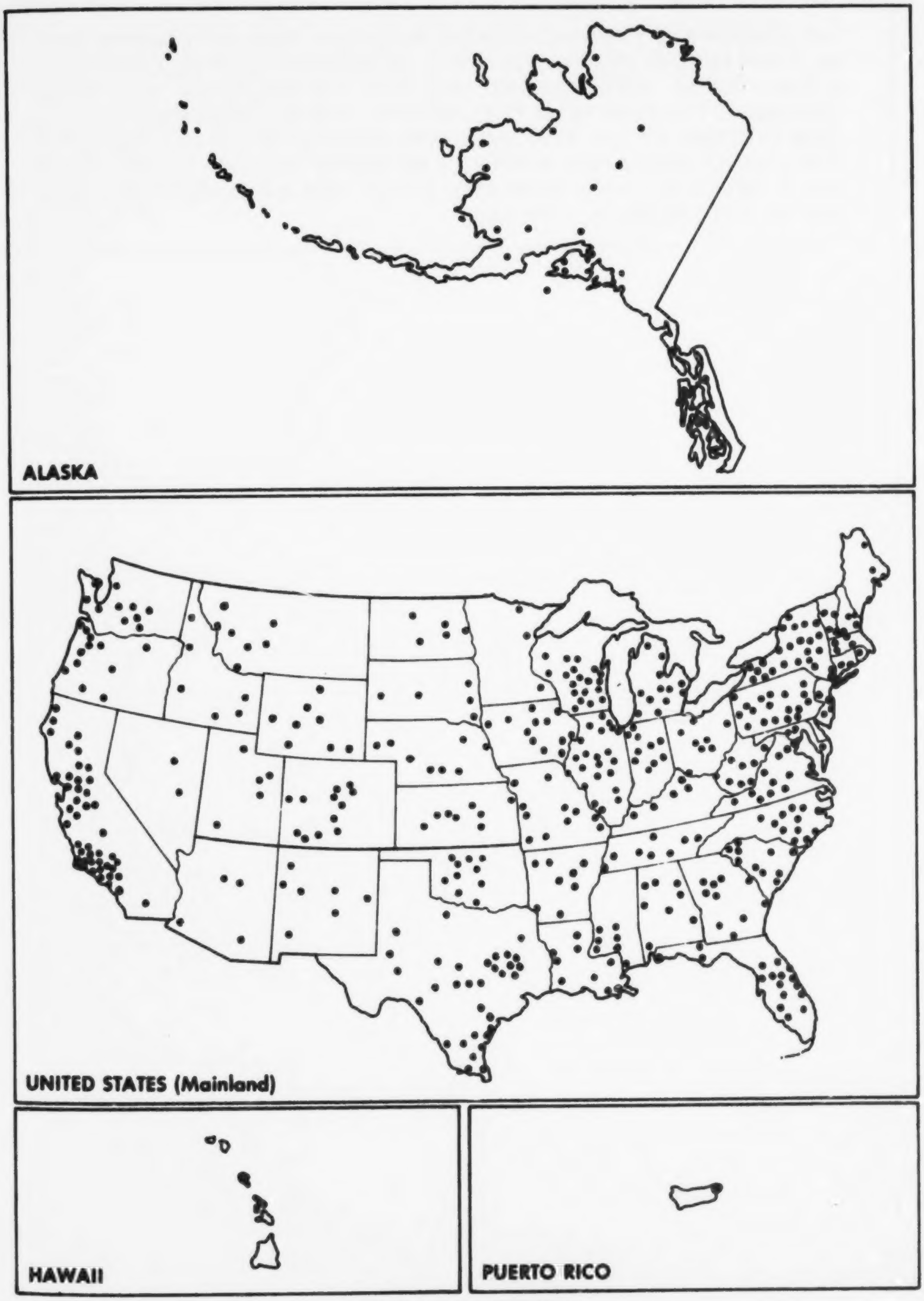
1990-2000 SYSTEM
NONDIRECTIONAL BEACON

ILS GROUND EQUIPMENT PROVIDES PRECISE LATERAL AND VERTICAL GUIDANCE TO PROPERLY EQUIPPED AIRCRAFT MAKING AN APPROACH AND LANDING ON AN ILS-EQUIPPED RUNWAY. THE PRESENT INVENTORY CONSISTS OF 842 FULL AND PARTIAL ILS SYSTEMS. FUTURE GROWTH AND IMPROVEMENTS WILL BE MINIMIZED; AND THE REPLACEMENT SYSTEM, MICROWAVE LANDING SYSTEM (MLS), WILL BE EXPEDITED. IN ADDITION, SYSTEMS ARE LOCATED ON OFFSHORE ISLANDS THAT ARE NOT DEPICTED ON THE MAP; E.G., ST. CROIX, VIRGIN ISLANDS; TAFUNA, SAMOA; AND AGANA, GUAM.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

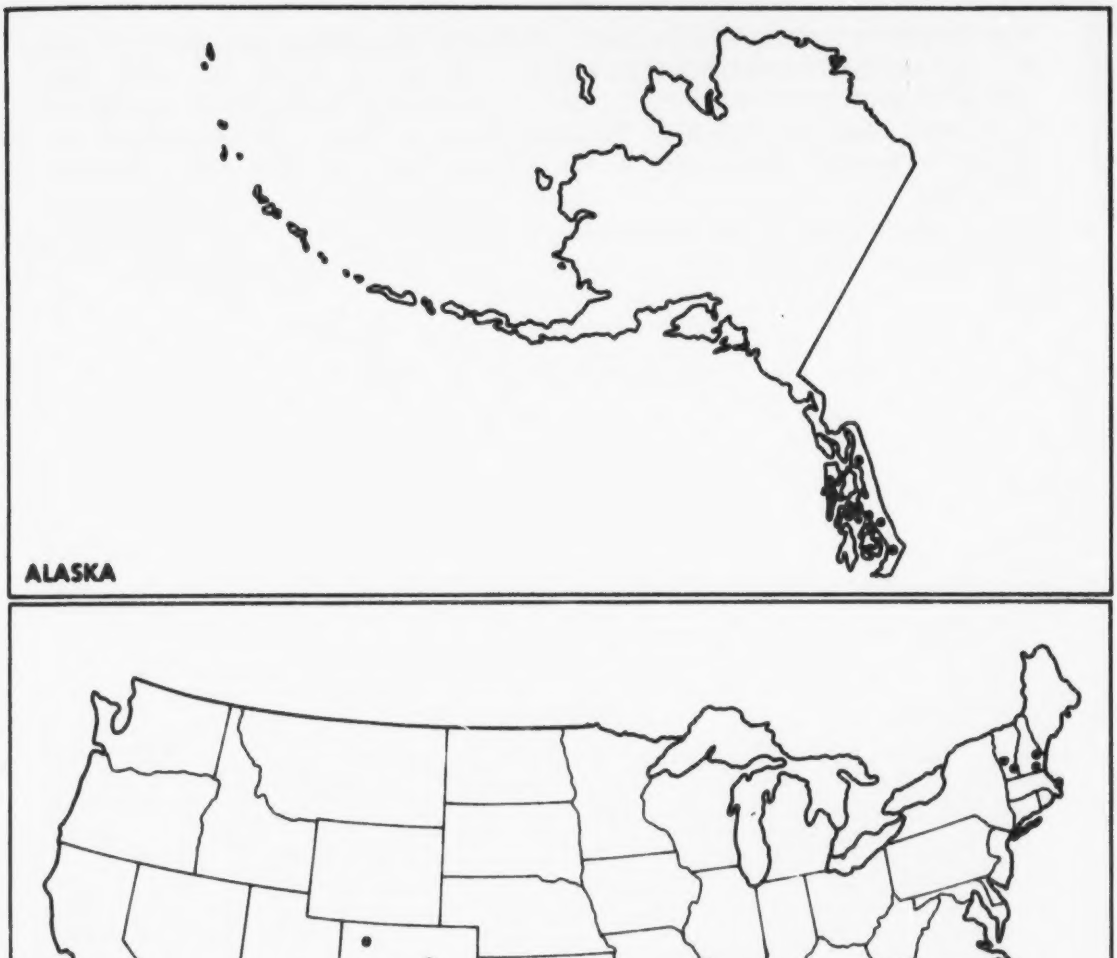
1981 SYSTEM
INSTRUMENT LANDING SYSTEMS

THE GROWTH SHOWN REPRESENTS THE CURRENT PLAN TO ESTABLISH APPROXIMATELY 26 FULL AND PARTIAL ILSs THROUGH FY-84. NO ILS ESTABLISHMENTS ARE FUNDED BEYOND FY-84. FY-85 AND FUTURE-YEAR REQUIREMENTS WILL BE SATISFIED BY MLS. THE ILS INVENTORY SHOULD REMAIN RELATIVELY CONSTANT AT APPROXIMATELY 870 FULL AND PARTIAL SYSTEMS. SOME ILSs MAY BE DECOMMISSIONED PRIOR TO 1995. HOWEVER, THE MAJORITY WILL BE AFTER 1995 WITH COMPLETION BY THE YEAR 2000. THE CURRENT ICAO PROTECTION END DATE FOR ILS IS 1995. IN ADDITION, SYSTEMS ARE LOCATED ON OFFSHORE ISLANDS THAT ARE NOT DEPICTED ON THE MAP (E.G., TAFUNA, SAMOA).


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

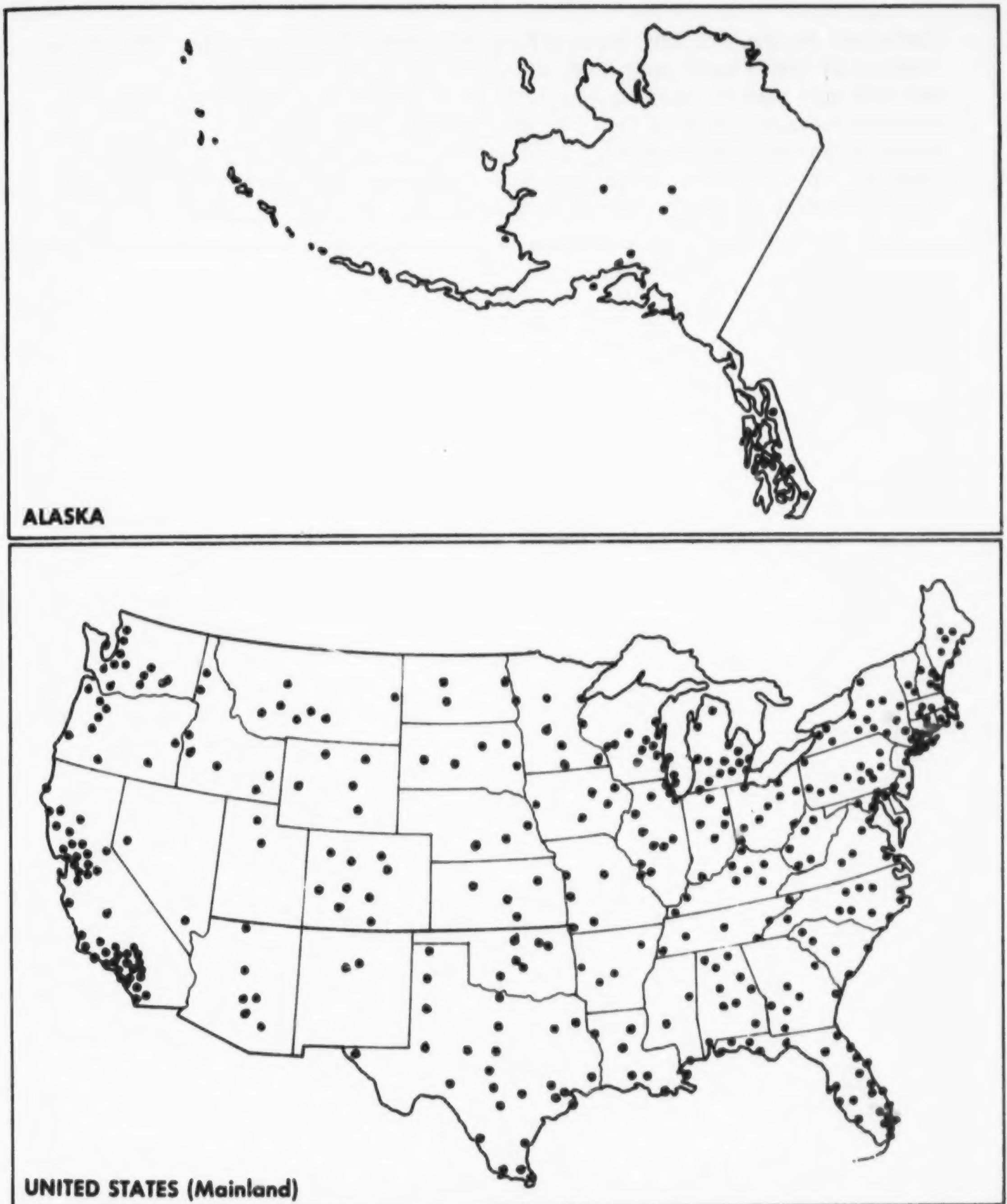
1985-1990 SYSTEM
INSTRUMENT LANDING SYSTEMS

THE MICROWAVE LANDING SYSTEM (MLS) IS A NEW ELECTRONIC ALL-WEATHER PRECISION APPROACH AND LANDING SYSTEM DEVELOPED AS AN INTERNATIONAL REPLACEMENT FOR ILS. THE PROGRAM WAS FIRST SCHEDULED FOR FUNDING IN FY-83 AND WILL CONSIST OF APPROXIMATELY 1,250 SYSTEMS BY THE YEAR 2000. IMPLEMENTATION OF MLS REQUIRES THAT THE ILS PROGRAM GROWTH BE MINIMIZED. TWELVE (12) LOCATIONS ARE SCHEDULED TO BE COMPLETED BY MID-1986. IMPLEMENTATION WILL UTILIZE A NETWORKING CONCEPT.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

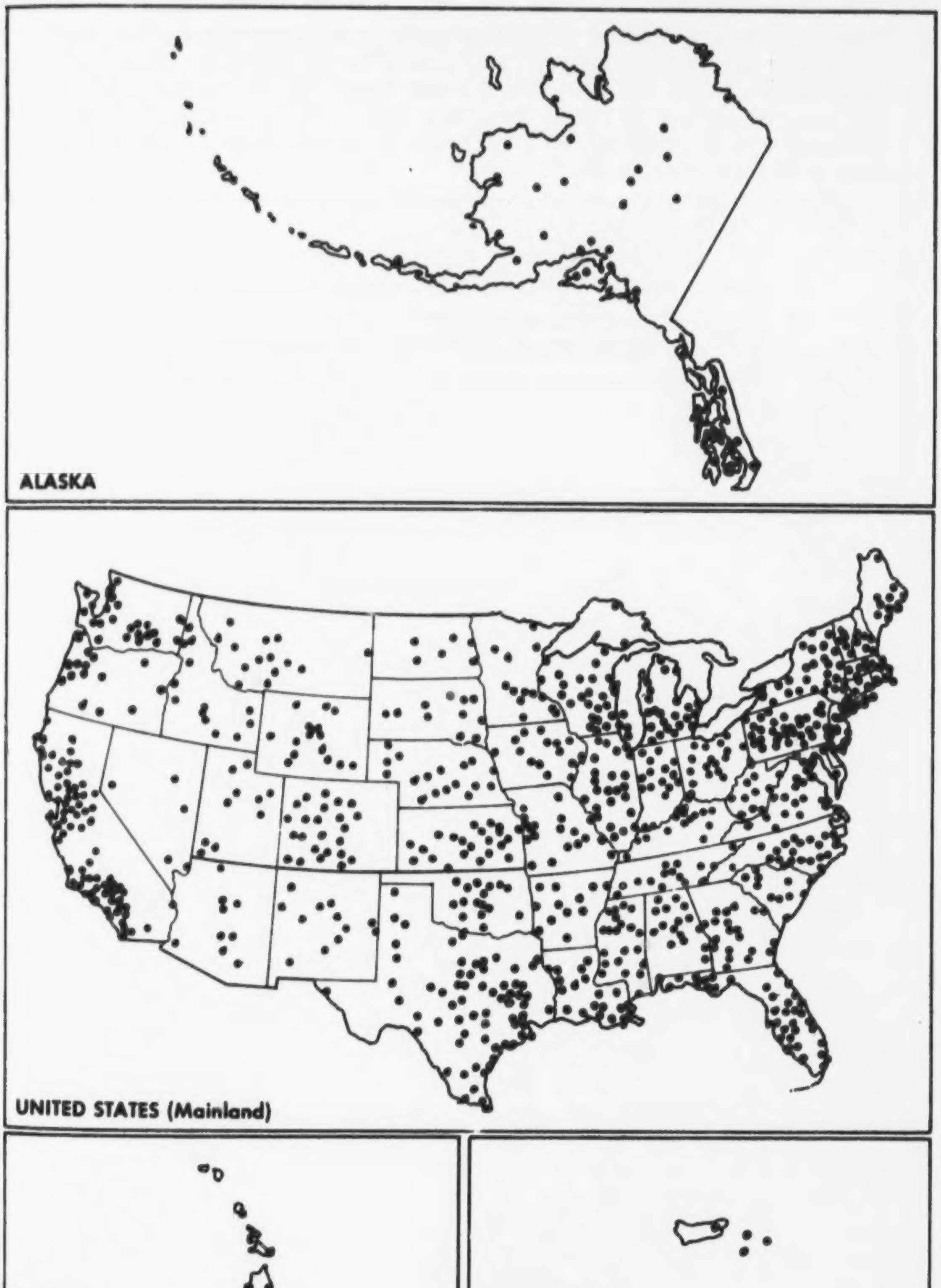
1985 SYSTEM
MICROWAVE LANDING SYSTEMS

THE GROWTH SHOWN REPRESENTS CURRENT PLANNING AND BUDGETING TO ESTABLISH APPROXIMATELY 340 ADDITIONAL MLSs BY 1990. ILS GROWTH HAS STOPPED. THE LOCATIONS SHOWN REPRESENT CURRENT PLANNING AND ARE SUBJECT TO CHANGE AS A RESULT OF MINIMIZED ILS GROWTH WHICH REQUIRES A RE-EVALUATION OF THE NETWORKING CONCEPT.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1990 SYSTEM
MICROWAVE LANDING SYSTEMS

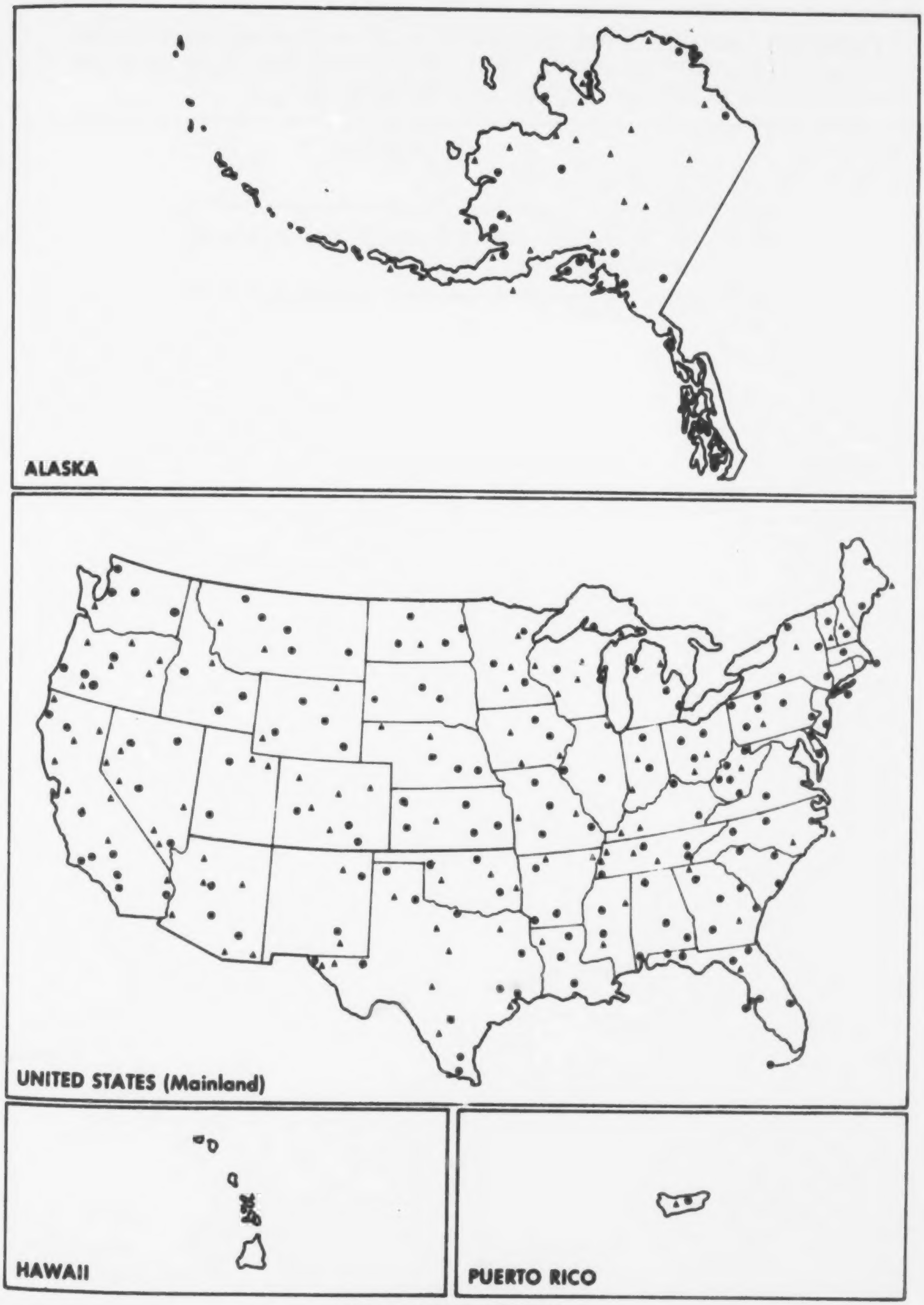
CURRENT PLANNING AND BUDGETING INCLUDE AN ADDITIONAL 895 MLSs THROUGH THE YEAR 2000 FOR A TOTAL OF 1,250 SYSTEMS. LOCATIONS SHOWN ARE FOR PLANNING AND MAY BE CHANGED DEPENDING UPON THE ACTUAL REQUIREMENTS THAT EXIST DURING THIS TIME PERIOD. ALL ILSs SHOULD BE DECOMMISSIONED UNLESS THE ICAO PROTECTION DATE IS EXTENDED. IN ADDITION, SYSTEMS ARE LOCATED ON OFFSHORE ISLANDS THAT MAY NOT BE INDICATED ON THE MAP; E.G., ST. CROIX, VIRGIN ISLANDS.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

2000 SYSTEM
MICROWAVE LANDING SYSTEMS

THIS MAP DEPICTS THE LOCATION OF DIRECTION FINDERS (DF). DFs ARE VHF RADIO RECEIVERS USED TO TAKE BEARINGS ON AIRCRAFT TRANSMITTERS. IN 1981 THERE WERE 175 DFs. BY 1985 THERE WILL BE 300 DFs, AND 50 DFs WILL BE ADDED BETWEEN 1990 AND 2000. THE LOCATION OF THESE SITES WILL BE DETERMINED AT A LATER DATE. NOT SHOWN ON THE MAP IS ONE DF IN AMERICAN SAMOA.

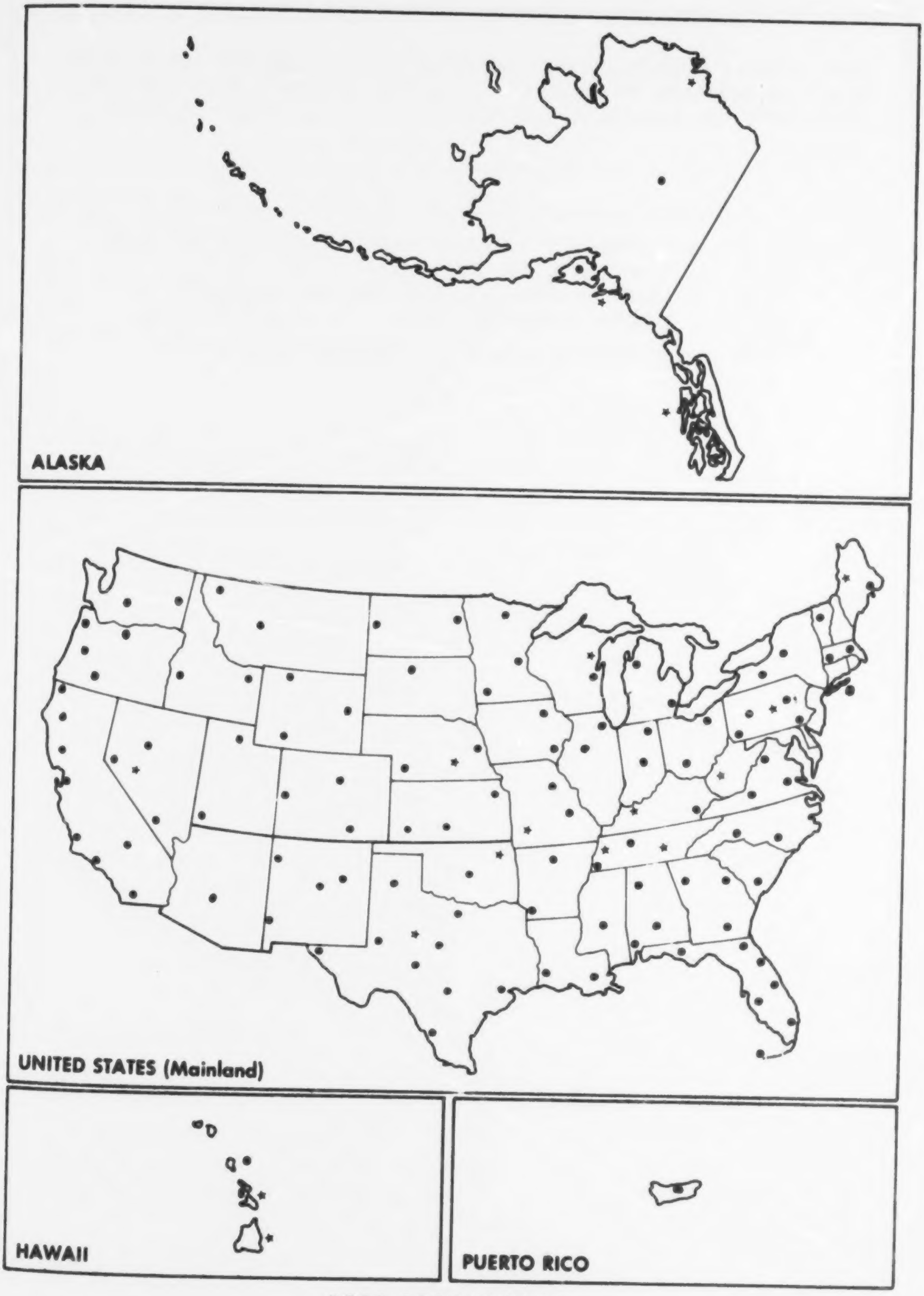
● EXISTING SITES (1981)
▲ SITES ADDED BETWEEN 1981 AND 1985


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1981-2000 SYSTEM
DIRECTION FINDERS

FROM 1981-1985 THE EN ROUTE SURVEILLANCE SYSTEM REMAINS ESSENTIALLY INTACT WITH 111 ARSRs AND 17 BEACON-ONLY SITES. IN ADDITION TO SITES DEPECTED, AN ARSR IS LOCATED IN GUAM.

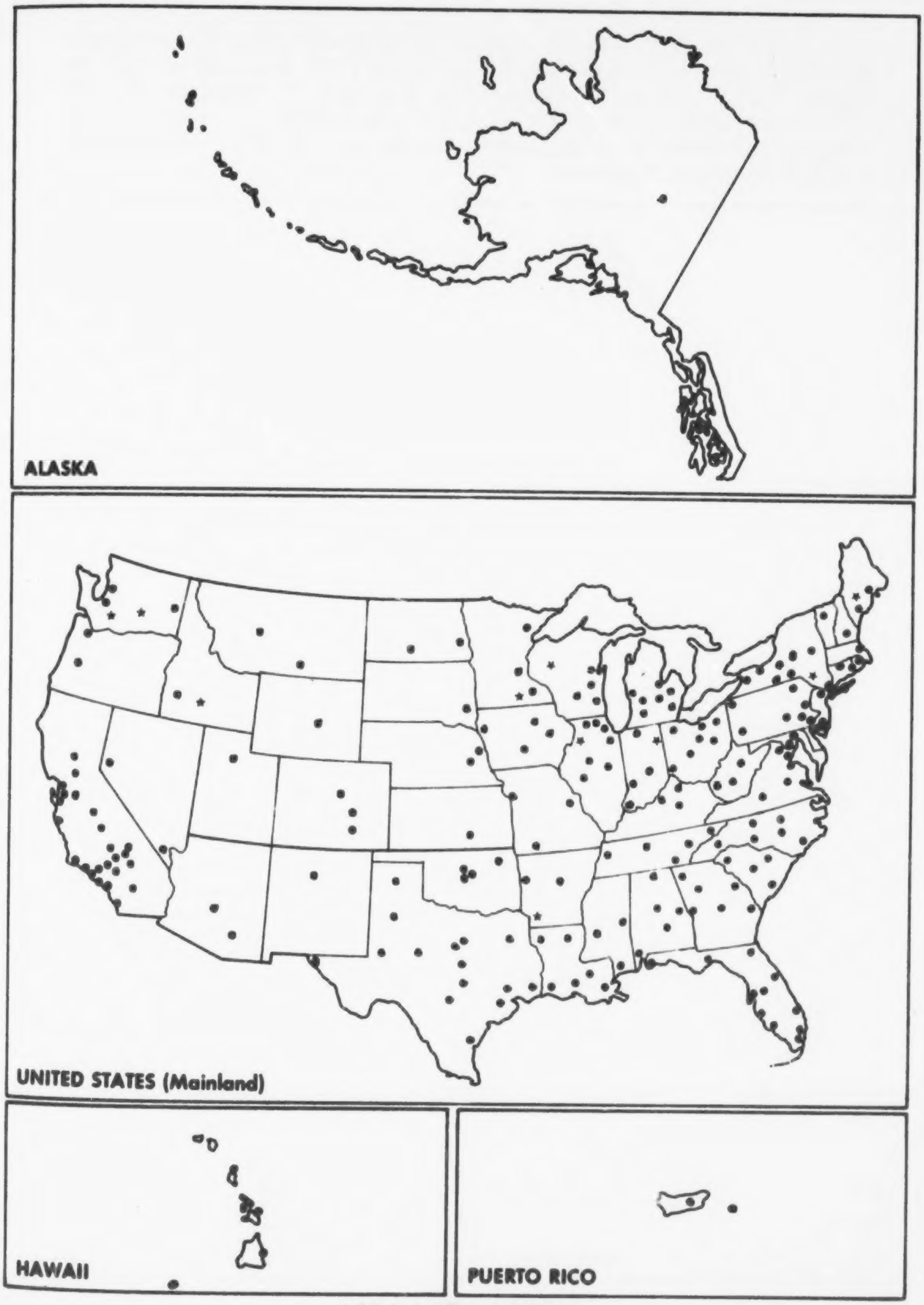
● AIR ROUTE SURVEILLANCE RADAR (ARSR)
★ BEACON-ONLY SITE


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1981-1985 SYSTEM
EN ROUTE SURVEILLANCE

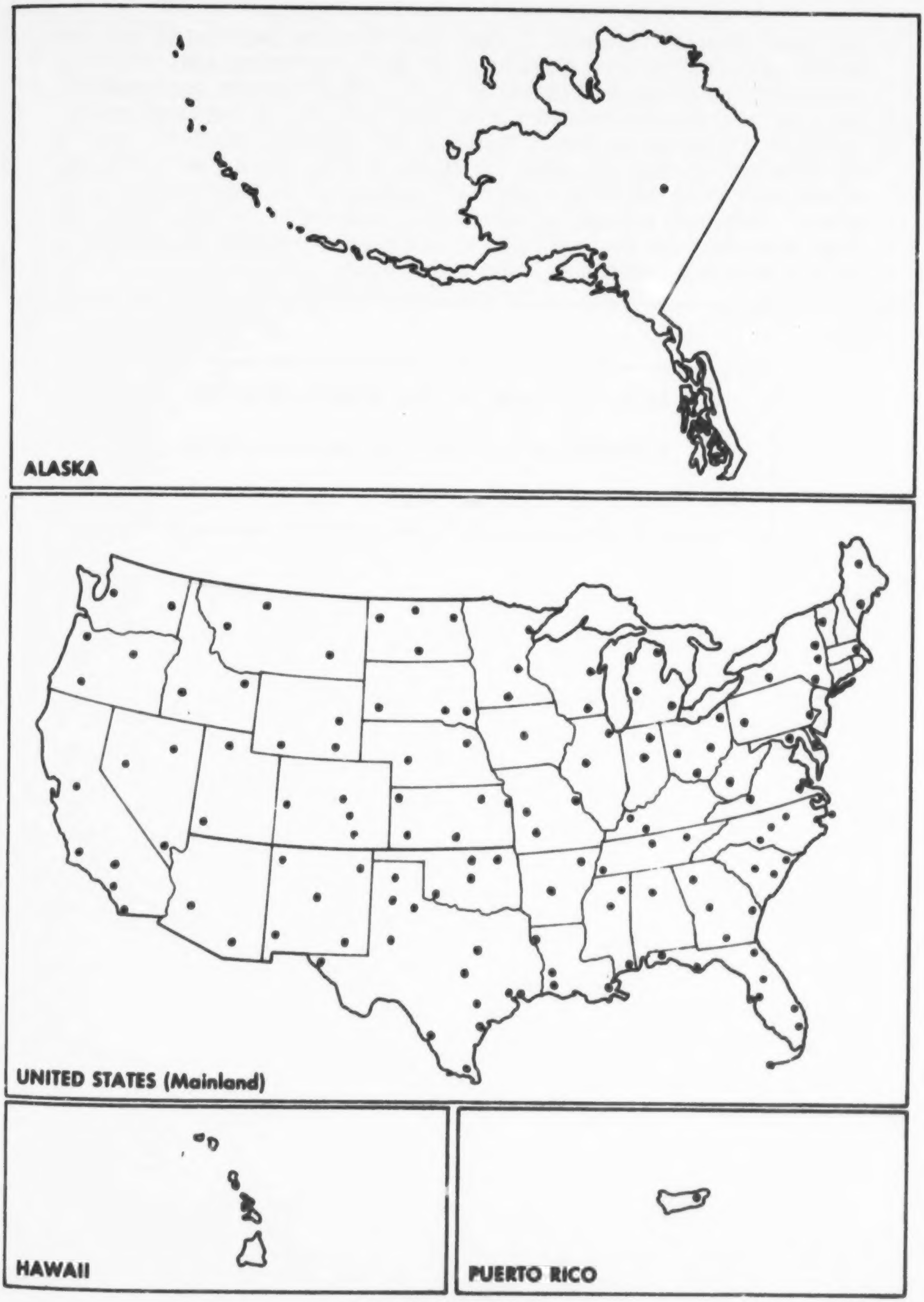
THE CURRENT 203 AIRPORT SURVEILLANCE RADARS (ASR) EXPAND BY 10 TO MEET THE DEMANDS OF INCREASING TRAFFIC. IN ADDITION TO THE LOCATIONS DEPICTED, ASRs ALSO EXIST ON OFFSHORE ISLANDS; E.G., GUAM.

● CURRENTLY EXISTING AIRPORT SURVEILLANCE RADARS (ASR)
IRPORT SURVEILLANCE RADARS ADDED
GH THE YEAR 2000


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1981-2000 SYSTEM
AIRPORT SURVEILLANCE RADARS

THE FUTURE AVIATION WEATHER RADAR SENSOR NETWORK WILL PROVIDE IMPROVED WEATHER INFORMATION AT 10,000 FEET AND ABOVE FOR EN ROUTE AREAS AND APPROACHING THE SURFACE OF DESIGNATED AIRPORTS. THE SENSOR NETWORK WILL BE COMPRISED OF SELECTED FAA TERMINAL RADARS WITH WEATHER CHANNELS AND NEXT GENERATION WEATHER RADARS (NEXRAD).


ALASKA
UNITED STATES (Mainland)
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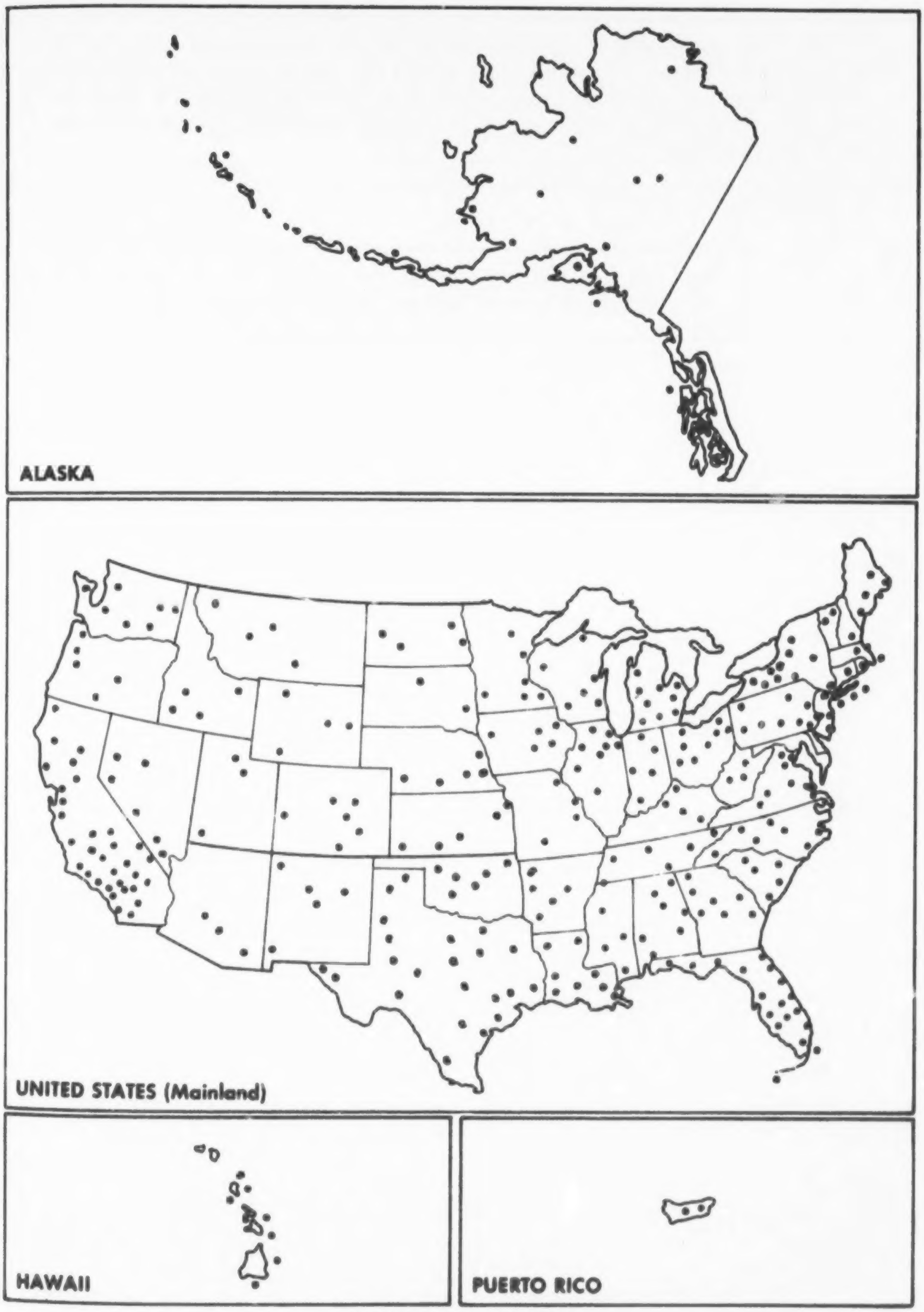
1990-2000 SYSTEM
AVIATION WEATHER RADAR NETWORK

EN ROUTE RADAR, TERMINAL RADAR, AND BEACON-ONLY SITES WILL BE NETWORKED TO PROVIDE COVERAGE OF BOTH EN ROUTE AND TERMINAL AIRSPACE. THE CURRENT SYSTEM OF 111 EN ROUTE RADARS, 203 TERMINAL RADARS, AND 17 BEACON-ONLY SITES EVOLVES TO A MORE COST-EFFECTIVE SYSTEM OF 94 EN ROUTE RADARS, 208 TERMINAL RADARS, AND 12 BEACON-ONLY SITES. BY 1990, 137 MODE S WITH DATA LINK HAVE REPLACED ATCBI TO PROVIDE 12,500 FEET COVERAGE. BY THE YEAR 2000, 197 MODE S SYSTEMS EXTEND COVERAGE TO 6,000 FEET. IN ADDITION, SYSTEMS ARE LOCATED ON OFFSHORE ISLANDS THAT MAY NOT BE INDICATED ON THE MAP (E.G., VIRGIN ISLANDS AND GUAM).

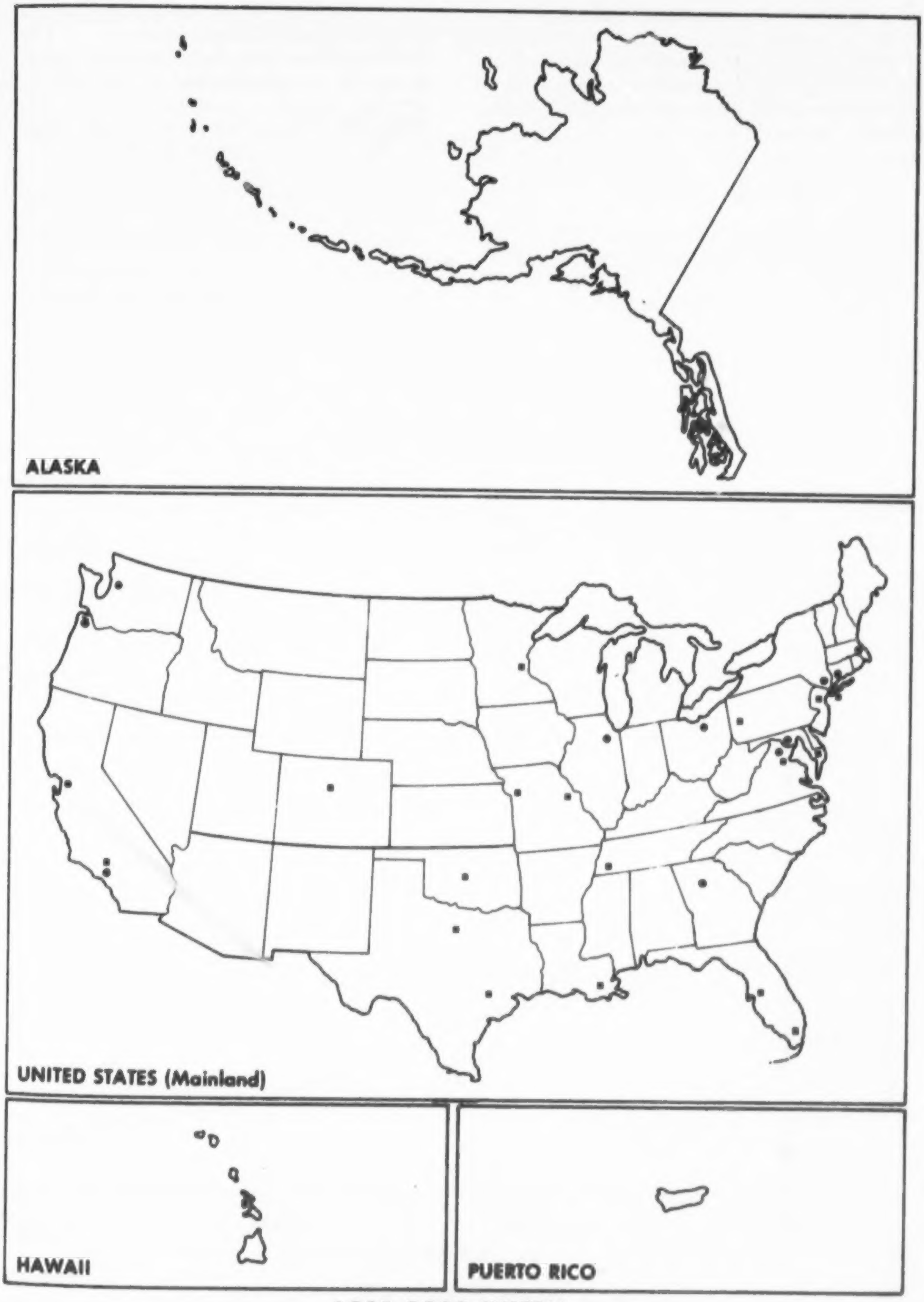
EN ROUTE RADARS WITH MODE S OR ATCBI
● TERMINAL RADARS WITH MODE S OR ATCBI
ATCBI OR MODE S SITES


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1990-2000 SYSTEM
SURVEILLANCE NETWORKS

THERE ARE CURRENTLY 12 AIRPORT SURFACE DETECTION EQUIPMENT (ASDE 2's) SYSTEMS. THESE WILL BE REPLACED BY SOLID-STATE ASDE 3's DURING THE PERIOD 1986-1990. ADDITIONAL ESTABLISHMENTS WILL INCREASE THE NUMBER OF ASDEs TO 21 SYSTEMS BY 1990 AND 29 SYSTEMS BY THE YEAR 2000.

● ASDEs IN PLACE IN 1981 TO 1985
■ SYSTEMS ADDED BETWEEN 1986 TO 2000


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1981-2000 SYSTEM
AIRPORT SURFACE DETECTION EQUIPMENT

RETURN ON THE INVESTMENT

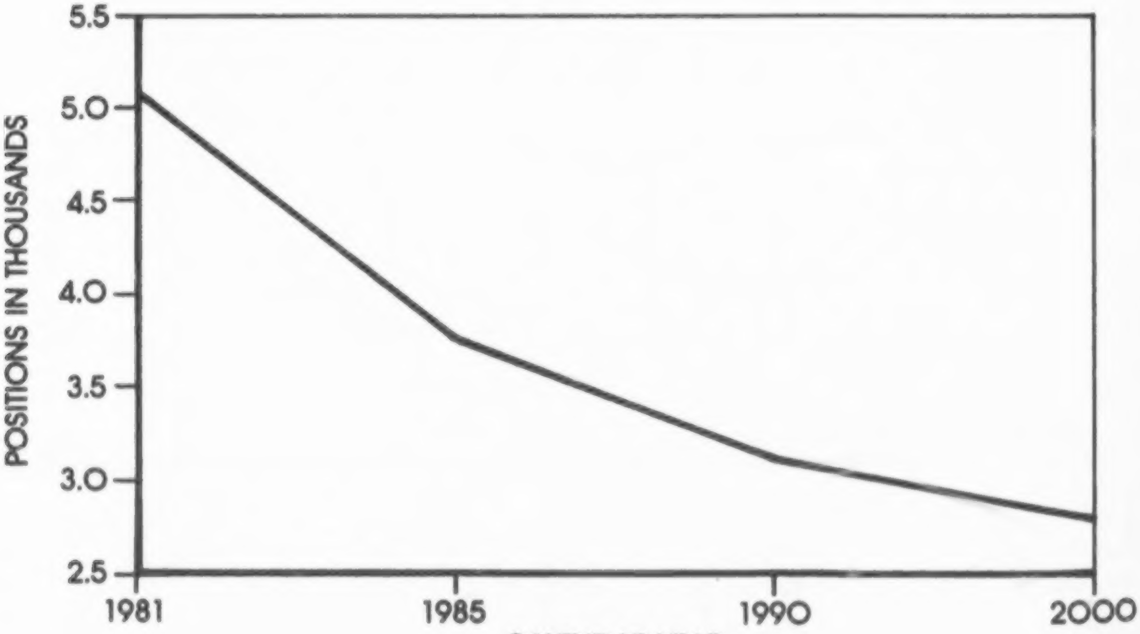
As a result of these planned actions, major improvements in service, system availability, and extended reliability will be achieved; and operating costs will be substantially reduced.

FIELD EMPLOYMENT

Employment levels reflect Airway Facilities sector manager and subordinate positions required to staff the ground-to-air system. Air Traffic employment is not required for these remote systems.

During the next 20 years, the ground-to-air system will undergo changes in hardware, software, and plant improvement. These will result in changes within Airway Facilities as shown in the chart below.

For this system, changes will have the net effect of decreasing current Airway Facilities personnel requirements at FAA field facilities by 45 percent in the year 2000.



AIRWAY FACILITIES EMPLOYMENT
(GROUND-TO-AIR SYSTEMS)

SUMMARY OF FACILITY CHANGES

1981—Airway Facilities employment for 11,640 facilities required a total of 5,057 people.

1985—The reduction of Airway Facilities staffing will be due primarily to the implementation of VORTAC replacement, solid-state ILS, ground-to-air communications equipment replacement, and installation of remote maintenance monitoring. This will reduce personnel requirements to 3,774 positions.

1990—Airway Facilities employment will continue to decrease during this time period in spite of the additional number of facilities established, such as MLS, NEXRAD, visual aids, airport surveillance radar (ASR), airport surface detection equipment (ASDE), VHF omnidirectional range test (VOT), etc. Facility establishment increases in personnel will be offset by consolidation of facilities, replacement of vacuum-tube equipment with solid-state, and remote-maintenance monitoring.

2000—Staffing requirements through the year 2000 will continue to decrease due to additional consolidation of facilities, reduction of facilities through networking, and the ultimate decommissioning of conventional ILS.

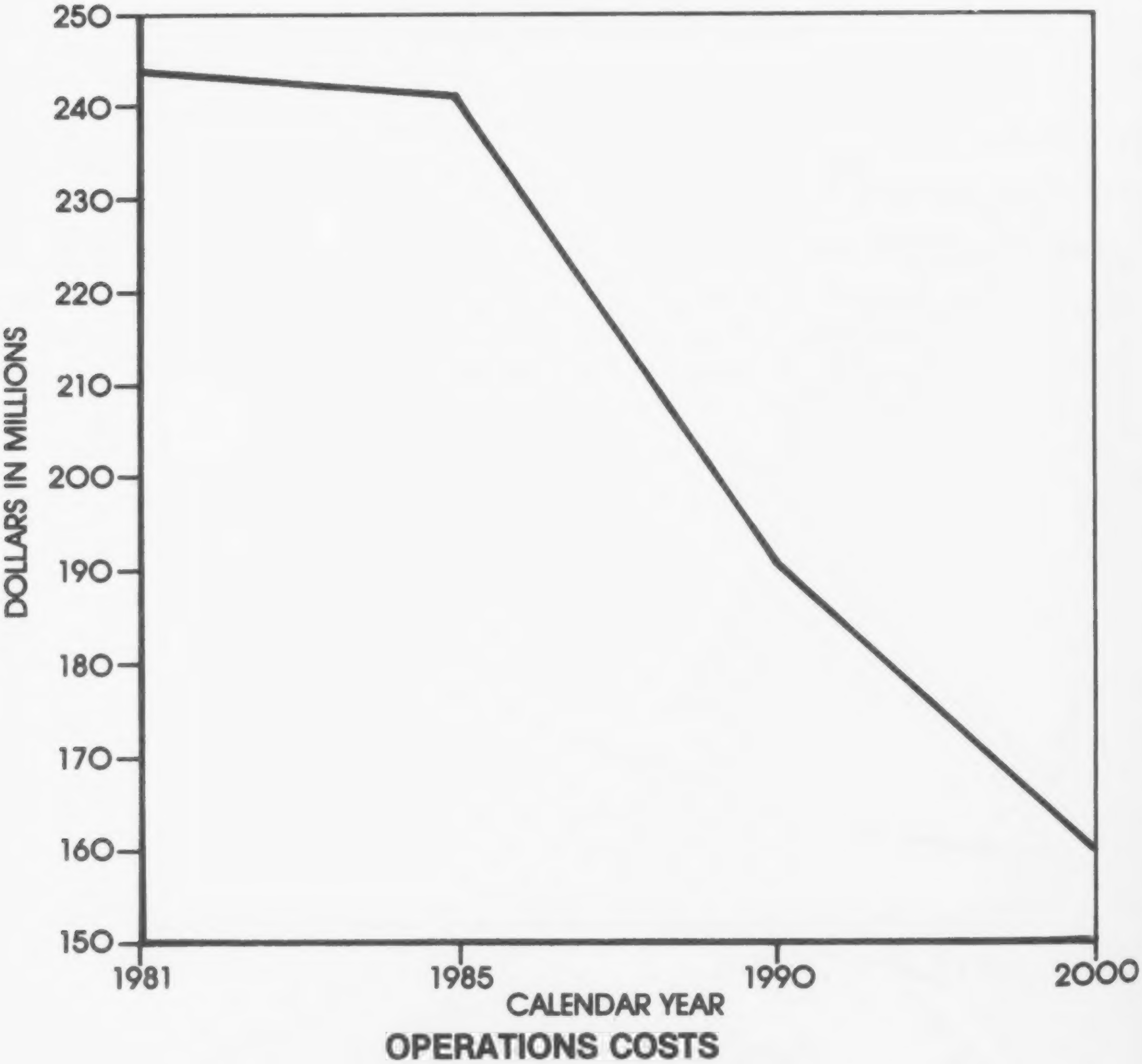
GROUND-TO-AIR SYSTEMS AIRWAY FACILITIES EMPLOYMENT CHANGES

	1981	1985	1990	2000
No. of Facilities	11,640	13,544	12,726	10,642
Airway Facilities Personnel	5,057	3,774	3,124	2,762
AF Productivity Quotient	2.30	3.59	4.07	3.85
Total AF Staffing	5,057	3,774	3,124	2,762

FIELD OPERATIONS COSTS

Operating costs cover estimated annual expenditures for field personnel, leased communications, rents and utilities, and other miscellaneous categories of items. The costs for each of the years in this plan are a direct consequence of the facility changes and their impact in these areas. Costs are in constant FY-81 dollars.

Airway Facilities personnel costs are derived by multiplying the total number of employee-years associated with the maintenance of field equipment by the average cost of an electronics technician in 1981: $34,100. A single cost figure has been used here due to the current composition of the AF work force and the expectation that trainee technicians and administrative positions will remain small compared to the overall field work force. These costs are summarized at the end of this section.



OPERATIONS COSTS

Rents and Utilities. A summation of estimated annual expenditures for all charges for renting equipment, land and buildings, local telephone service, electric service, gas service, water service, etc. The number of facilities in the ground-to-air system will increase slightly through 1990, and the cost associated with rents and utilities will similarly increase. Rental costs tend to increase for privately owned property since current leases were negotiated at a time of lower property values. By the year 2000, costs will decrease due to consolidation.

Other. All other services not otherwise classified, such as storage of household goods, automotive maintenance and repair, aircraft rental, repair of technical building facilities and grounds, etc.

The table below summarizes annual operations costs in the ground-to-air system.

GROUND-TO-AIR SYSTEMS OPERATIONS COSTS (000)

	1981	1985	1990	2000
Airway Facilities Personnel	172,444	128,693	106,528	94,184
*Leased Communications	25,000	70,000	50,000	35,000
Rents & Utilities	27,673	17,475	14,465	12,790
Other	18,969	24,385	20,185	17,848
Totals	244,086	240,553	191,178	159,822

*Costs shown are best estimates at time of publication. Actual costs may differ due to negotiated tariffs.

Leased communications costs consist primarily of dedicated circuits from ARTCCs, ATCTs, TRACONs, and FSSs to remote communications sites (e.g., RCAGs, RTRs, and RCOs) and control/monitoring circuits for remote navigational aids (VORTACs, NDBs, and DFs). Some ILS facilities are monitored over dedicated leased circuits, and some long-range radar and beacon-only sites also use dedicated circuits to transmit data. Changes expected are:

1981-1985—Costs will rise dramatically beginning in 1984 due to new tariff structures brought about by the divestiture of AT&T. Where possible, circuits are being transferred to FAA link systems and other agency transmission media. The RML system is being expanded and modified to transmit much of the voice and data required by the remote sites, but little will be completed prior to 1989.

1985-1990—Costs will reduce as many circuits are rerouted to FAA transmission media. Data is concentrated on fewer circuits (via multiplexing modems) and consolidation of many communications facilities. Costs will remain high as many remote facilities will be some distance from any FAA link drop; thus, leased circuits will still be necessary.

1990-2000—Costs will drop further as facilities are maximally consolidated and the FAA link network is expanded to accommodate additional circuits. Costs will essentially level out early in the period.

SPECIFIC PROJECTS

The plan calls for 16 separate projects related to upgrading the ground-to-air system, falling under four basic categories: communications, navigation, landing systems, and surveillance.

PROJECTS	IMPLEMENTATION	
	FIRST	LAST
COMMUNICATIONS		
1. Air/Ground (A/G) Communications Equipment Modernization	1980	1987
2. Communications Facilities Consolidation	1985	1990
NAVIGATION		
3. VORTAC	1981	2000
4. Nondirectional Beacon (NDB)	1984	2000
5. Supplemental Navigation System Monitors	1988	1990
LANDING SYSTEMS		
6. Instrument Landing System (ILS)	1981	1986
7. Microwave Landing System (MLS)	1986	1999
8. Runway Visual Range (RVR)	1983	1989
9. Visual Navaids	1982	2000
10. Approach Lighting System Improvement Program (ALSIP)	1984	1991
SURVEILLANCE		
11. Direction Finder (DF)	1982	2000
12. Mode S/Data Link	1986	1994
13. Terminal Radar (ASR) Program	1986	1995
14. Airport Surface Detection Equipment (ASDE 3) Radar	1988	1990
15. Long-Range Radar Program	1985	1995
16. Weather Radar Program	1988	1992

PROJECT SUMMARY

PROJECT 1: Air/Ground (A/G) Communications Equipment Modernization

Purpose: This project will replace obsolete tube transmitters and receivers with solid-state models capable of operating in a 25-kHz channel environment. The project also replaces old antennas with state-of-the-art designs that will enhance the A/G communications system and permit the use of lower transmitter output power.

Increases in the demand for communication services in air traffic control have generated a requirement for additional channels. This can only be accomplished in the frequency spectrum by decreasing the channel spacing to 25 kHz. The reduction of channel spacing to 25 kHz cannot be economically accomplished with the tube-type equipment. Conversion to solid-state equipment also provides cost savings through reduction in maintenance manpower and power consumption.

Approach: The project was planned on a multiyear basis to be procured in three phases.

- Phase I—replace en route A/G facilities (completed).
- Phase II—replace terminal A/G facilities (1981-1984).
- Phase III—replace FSS A/G facilities (1984-1985).

Tube-type equipment replaced by this project will not be relocated or installed at new sites. Current plans call for replacing multichannel tube-type equipment with dedicated single-channel transmitter/receivers for each operating frequency. This approach is generally the most cost effective and reliable course of action. However, consistent with consolidation efforts, some remotely tuneable transmitters/receivers and improved receivers for use in high radiofrequency interference area may be required.

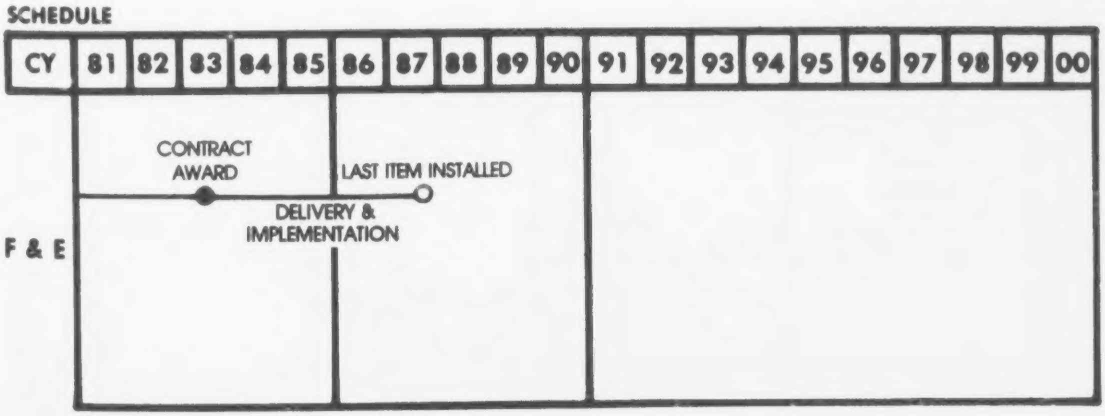
Products: The planned acquisition schedule is as follows:

FY	No. of Trans/Rec	Antennas
81	3,700	2,300
82	2,400	3,200
83	3,100	7,800
84	4,500	9,000
85	4,500	3,000

Related Projects/Activities: This project, along with other FAA efforts for providing remote maintenance monitoring equipment and communication facility consolidation, contribute to FAA's program to modernize radio communication. Remote monitoring subsystems (RMS) which have been previously funded will support the remote monitoring of 409 sterile en route A/G facilities from 23 ARTCCs. Remote monitoring subsystems for the remainder of air/ground communication facilities will be acquired under the radio control equipment (RCE) project.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				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CONTRACT AWARD
LAST ITEM INSTALLED
DELIVERY & IMPLEMENTATION

PROJECT 2: Communications Facilities Consolidation

Purpose: This project will reduce the cost of operating radio communications facilities. This project allows for the provision of air/ground communication from larger, more cost-effective consolidated remote communications facilities (RCF) in lieu of the existing large number of facilities (approximately 2,800 remote transmitters/receivers (RTR), remote center air/ground communications facilities (RCAG), remote communications outlets (RCO), and backup emergency communications (BUEC).

- The consolidation and relocation of remote communication facilities will result in the establishment of communication facilities which serve the combined needs of air traffic control and flight service station facilities.

- Consolidation of these facilities into VORTACs, hub RTR, and other FAA facilities is the final step in FAA's program to provide a modern solid-state remote-monitored radio communications network. These efforts result in cost savings and avoidance through: reduced land leases, reduction in maintenance travel, reduced power consumption (heating and air conditioning for separate buildings), and reduction in leased services. These cost savings and cost avoidance will result in approximately $39.6 million per year.

Approach: Multiple RTR facilities at many airports will be consolidated when solid-state receivers and transmitters, remote control equipment, and remote maintenance monitoring (RMM) are installed. FSS communications not already at VORTACs will be consolidated at 300 VORTAC facilities. New and existing RCAGs will be co-located with VORTAC and other FAA-owned facilities. A frequency interference study is required prior to combining large numbers of transmitters and receivers. Development of receiver multicouplers and transmitter combiners is needed to reduce the number of antennas required, especially at VORTACs. This project also includes interference suppression devices and ancillary devices such as multicouplers, combiners, filters, and cavities. Maximum facility size has been estimated to be 24 frequencies.

Regional network studies are underway to determine the precise number of facilities needed. A national plan will be developed using the regions network plans. The goal will be to provide coverage down to 2,000 feet above ground level (except in areas of low activity) and to provide lower altitude coverage in areas of special concern (such as military training routes and areas of high rotorcraft activity).

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

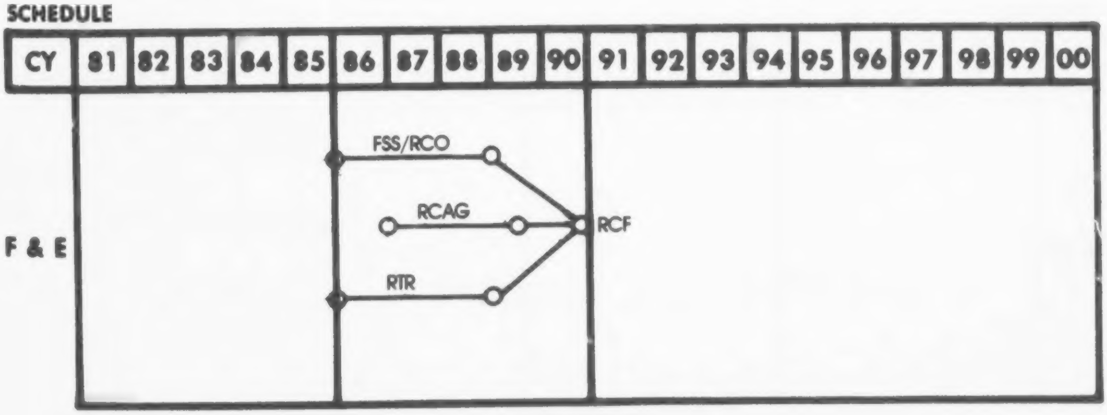
Products: For planning purposes, a preliminary estimate of 1,118 facilities is being used. The remote communications facilities (RCF) outlets will be housed in:

VORTAC/RCF	465
Hub RTR/RCF (new buildings)	125
Existing buildings	528
Total	1,118

- The VORTAC consolidation schedule is 65 in FY-86, 139 in FY-87, 100 in FY-88, and 161 in FY-89.
- The consolidated hub RTR building schedule is 81 in FY-86 and 44 in FY-87.
- The RCAG relocation schedule is 100 for FY-87, 76 in FY-88, 211 in FY-89, and 141 in FY-90.

Related Projects/Activities: Solid-state transmitter/receiver and radio control equipment must be implemented to avoid relocation of obsolete equipment. The navaid and radar networking plans and the National Airspace Review are required to finalize facility topology. These consolidated facilities will include RMM capability and contain standard RMM equipment. Electromagnetic compatibility (EMC) studies are currently being conducted to develop EMC guidelines necessary for compatible consolidated sites.

SCHEDULE



PROJECT 3: VORTAC

Purpose: Very high frequency omnidirectional ranges (VOR) with distance measuring equipment (DME) or TACAN are en route air navigational and approach aids used by pilots to conduct safe and efficient flights and landings. This project forms a modern cost effective national navigation network which provides required coverage through replacement, relocation, conversion, and establishment of VORTAC and VOR/DME.

- Replacements. During FY-78 to FY-83, the FAA budgeted to replace all existing vacuum-tube VOR and VORTAC systems with modern solid-state equipment. This new equipment is currently under contract and replacements have begun.

- Relocations. Due to the operational decline, site suitability, route structure changes, or real estate consideration, it is necessary to relocate facilities as required.

- Conversions. Doppler VORs solve unique siting problems and allow coverage requirements to be met with fewer VORs.

- Establishments/Non-Federal Takeovers. Operational requirements that arise in various geographic areas necessitate that FAA increase system capacity by implementing VHF navigational aid service. Current plans do not envision an increase in the total population. Equipment for these takeovers/establishments must come from facilities determined to be redundant under the networking plan.

Approach: Complete the replacement of all existing equipment with standard solid-state systems which include remote monitoring and control capability and add DME. Tube-type VOR test (VOT) equipment will be replaced with solid-state equipment and co-located with other facilities where possible. A national network plan will be developed to redistribute VORs to meet operational requirements. Additional VOTs will be established to provide VOR checkpoints lost under the networking plan.

Products:

	1981-1985 Quantity	1986-1990 Quantity	1991-2000 Quantity
Replace VORTAC	718		
Replace VOR/DME	224		
Convert SSB DVOR to DSB DVOR	42		
Convert VOR to DSB DVOR	13	10	10
Retrofit DVOR w/RMM	55		
Establish VOT	35		
Replace VOT		77	
Co-locate VOT			112

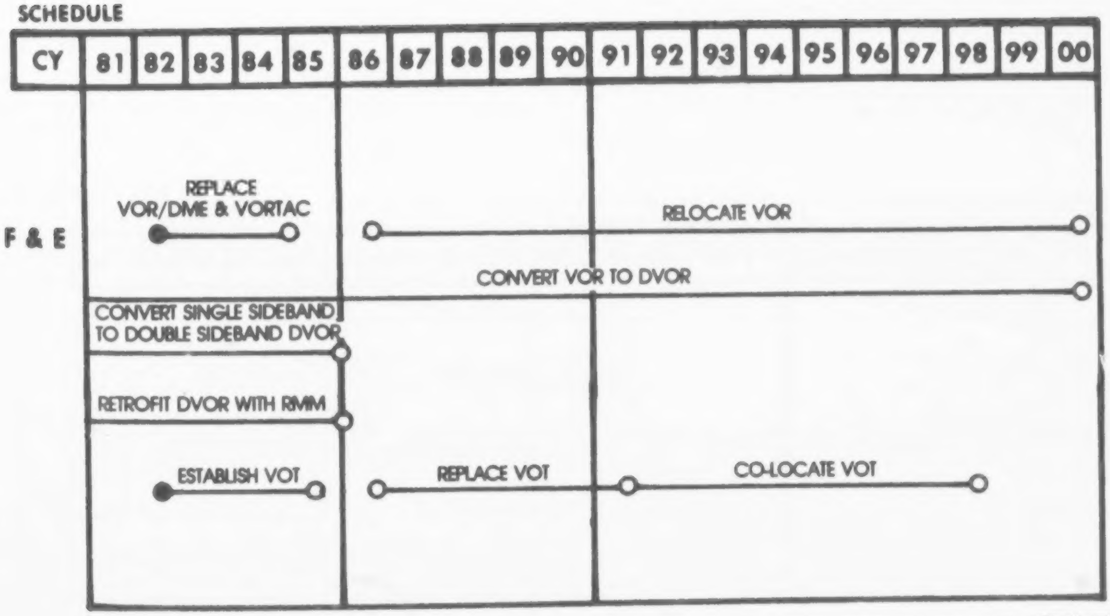
Related Projects/Activities: Automated FSS, NADIN, RMM, DF NDB, co-located communications, and AWOS. Remote communications facilities (RCF), DF and AWOS facilities will be co-located at many VORTACs (after conversion to solid state). RMM will be required to accommodate all combined facilities. The locations of combined facilities will depend on network studies.

Frequency and spectrum engineering is required to provide frequency protection for the proposed networking concept and provide noninterfering frequencies for high-powered VOT locations. In addition, the plan to co-locate navigational, surveillance, and communication facilities requires frequency engineering studies and guidelines.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

SCHEDULE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F & E
REPLACE VOR/DME & VORTAC
RELOCATE VOR
CONVERT VOR TO DVOR
CONVERT SINGLE SIDEBAND TO DOUBLE SIDEBAND DVOR
RETROFIT DVOR WITH RMM
ESTABLISH VOT
REPLACE VOT
CO-LOCATE VOT

PROJECT 4: Nondirectional Beacon (NDB)

Purpose: The nondirectional beacon (NDB) is a low/medium frequency facility that transmits omnidirectional signals whereby the aircraft pilot can navigate by determining the bearing from or to the station. NDBs are used for standard instrument approach procedures (SIAP), to supplement other navaids which support SIAPs, and for en route navigation. Additional facilities are required for operational purposes; obsolete facilities need to be replaced; and some existing facilities require relocation. Retrofitting with remote maintenance monitoring (RMM) capability is also required.

Existing tube-type systems are manpower-intensive and very costly to support. New systems will provide savings in energy consumption, improve reliability/availability, and reduce site visits. Existing facilities that are in separate buildings are costly to support. Relocating NDB facilities will improve maintainability and reduce cost of operation. Selected retrofitting of NDBs with RMM capability will improve the reliability and availability of existing solid-state systems.

Approach: Establish, replace, retrofit, co-locate NDBs, and add RMM as appropriate. The establishment of additional facilities on a noninterfering basis, within a limited radiofrequency band, may require that individual site bandwidths be narrowed. This will eliminate the NDB's voice feature.

Products:

	1981-1985 Quantity	1986-1990 Quantity	1991-2000 Quantity
Establish NDB	21	48	
Replace NDB		187	
Retrofit NDB		434	
Co-locate NDB		400	

TOTALS BY TARGET YEAR

	1981	1985	1990	2000
NDB (H, HH & COMLO)	600	621	669	669

The following assumptions have been made in developing quantities to be procured:

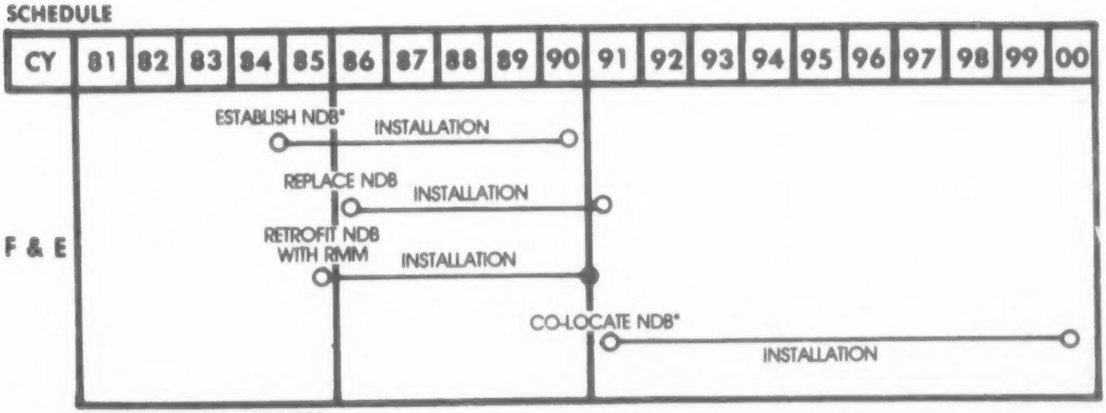
- There will be a reduction in the cost of NDB operational systems.
- Both terminal and en route NDBs are included.
- NDBs will be co-located with existing FAA facilities where feasible.

Related Projects/Activities: RMM capability and co-location at other facilities such as RCF. Locations and total numbers of NDB facilities will depend on network studies. Frequency and spectrum management aspects of co-located facilities must be studied.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

SCHEDULE



*CONSOLIDATION ACTIVITIES

PROJECT 5: Supplemental Navigation System Monitors

Purpose: VOR/DME is the international standard for civil air navigation and will remain into the next century. Other navigation systems that provide service in the NAS in conjunction with VOR/DME are termed supplemental systems. The satellite-based global positioning system (GPS) will become operational by the end of 1988 and will serve as a supplemental system for civil aviation in addition to its primary role as a U.S. military positioning system.

Use of any navigation aid in the NAS by civil aviation requires FAA approval. Beyond the approval of avionics performance, it is necessary for the FAA to monitor GPS satellite signals in order to be immediately aware of the total GPS navigation situation. Monitor data will be used to inform air traffic personnel of the status of GPS navigation so that they may issue clearances and advice to pilots of controlled aircraft. During the nonprecision approach phase of flight, the communication of GPS status to aircraft is necessary.

Approach: GPS monitors will be deployed to support en route and terminal phases of flight. Prior to deployment, an analysis will be needed to select the specific sites for these monitors based on satellite orbit, configuration, and availability of government facilities to house the monitors. Monitors will transmit data to central points for processing.

Six monitors should be adequate for en route operation advisories. The actual number of monitors that will be needed for approach operations is not known and will have to be determined.

Products:

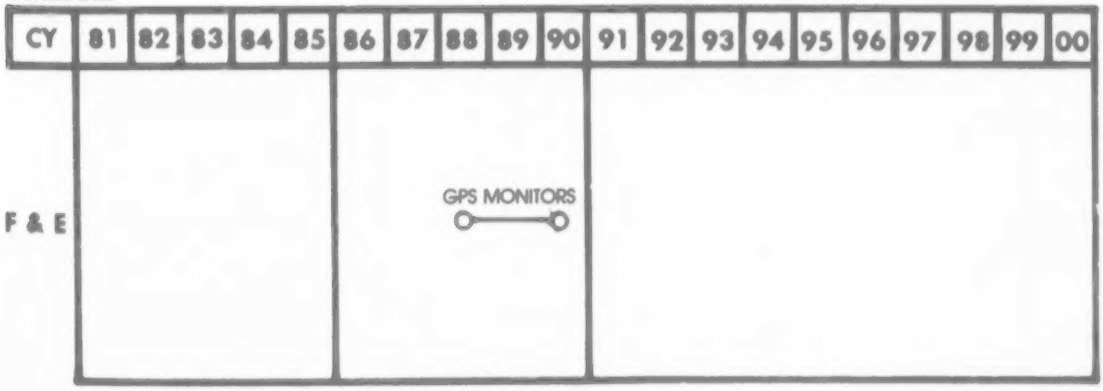
	1988-1990
GPS monitors for en route support	6

Related Projects/Activities: Nonprecision approach design; ATC automation.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

SCHEDULE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GPS MONITORS

PROJECT 6: Instrument Landing System (ILS)

Purpose: This project will provide for the establishment and upgrading of conventional instrument landing systems (ILS). Systems to be established are those required and qualified under the Airway Planning Standard, those in other special programs such as the Commuter Airport Program, and those at locations specifically named by Congress. Airports with 2,500 or more annual instrument approaches by certificated route air carrier aircraft are eligible for Category II ILS facilities which permit landing operations with 100-foot decision height and 1,200 feet runway visual range.

Additionally, FAA plans for implementation of the microwave landing system (MLS) include an extensive transition period into the 1990's. During this period, the present conventional instrument landing systems must continue in operation to provide time for the aviation community to equip their aircraft with the required avionics and to allow for MLS ground equipment procurement and deployment. To avoid increasingly difficult and costly support problems, it is planned, in the interim period, to replace tube-type components of approximately 188 instrument landing systems on a selective basis as described below. No ILS establishments are funded beyond FY-84 and solid-state replacement components for ILS will not be reprogrammed to new establishments.

Approach:

- Category I Establishment. New ILS equipment establishment will be kept to a minimum in line with FAA's plans for early implementation of MLS.

- Replacement. Tube-type ILS equipment will be replaced at those airports which are not scheduled to receive MLS equipment prior to 1990. Systems to be replaced are those at airports which have only one ILS or have a tube-type ILS on the prime instrument runway. A portion of these replacements will be accomplished using equipment or funds recovered from ILS establishment projects that were reprogrammed to MLS. The balance will be provided by modifying the ongoing ILS contract.

- Category II Establishment. Three Category II locations included in the FY-80 through FY-82 budgets will receive equipment under the Category II/III ILS "leapfrog" project. Category II equipment displaced by the installation of a Category III system was shipped to a Category II site in FY-82. New Category II sites will require the concurrent installation of an ALSF 2 system and additional runway visual range systems to provide horizontal visibility at touchdown, middle, and rollout at the end of the runway.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

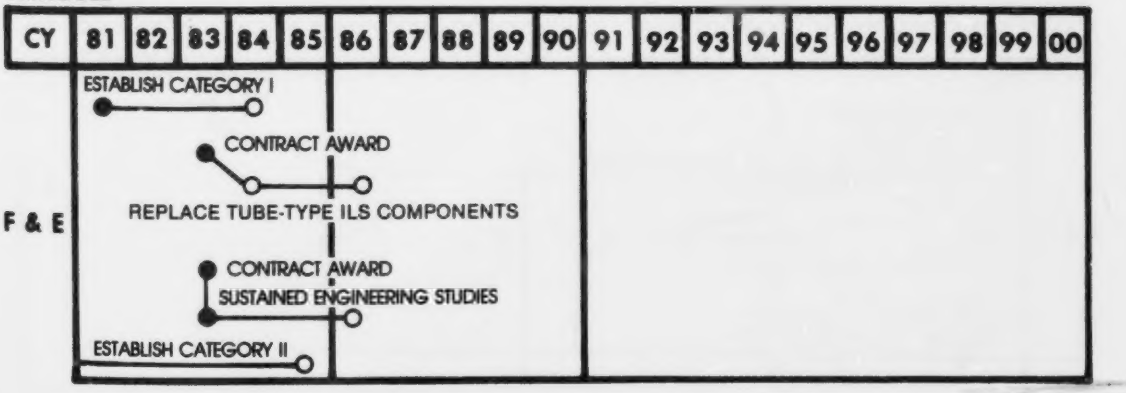
Products:

- Establish Category I (FY-84 and prior):
  - —22 full systems
  - —4 partial (localizer)
  - —12 partial (glide slope)
- Replace tube type:
  - —133 full systems
  - —55 partial
- Establish Category II:
  - —3 systems (implementation of 2 systems is complete)

Related Projects/Activities: Subsequent to these reestablishments,all new landing systems will be MLSs. Where cost effective, ILS will be remote maintenance monitored. Qualifying facilities receive medium-intensity approach lighting systems with runway alignment indicator lights (MALSR) and/or runway visual range (RVR).

NAS spectrum engineering support is required for ILS establishment.

SCHEDULE



READEX FICHE

PROJECT 7: Microwave Landing System (MLS)

Purpose: MLS has been adopted by the International Civil Aviation Organization (ICAO) as a world standard to replace ILS. It provides precision guidance to satisfy the full range of operational requirements, both civil and military, to all types of aircraft in all categories of landings. It overcomes the inherent limitations of existing ILSs. Radiated signals are minimally affected by surrounding terrain, structures, and weather effects, thereby, providing low-cost installation in all airport environments. The MLS with RMM capabilities will reduce the manpower requirements associated with ILS. The MLS will eventually provide multiple-curved and segmented approaches and selectable glide slope angles. To provide full accuracy for MLS, a precision distance measuring equipment (DME/P) with 100-foot accuracy will be required. This DME/P must provide service to conventional DME users.

Approach: In FY-84, procure initial quantities of production quality systems. Standard system funding—15 systems in FY-82 and FY-83; 22 systems in FY-84 (2 for training and test bed); 60 systems in FY-85 and FY-86, and 100 systems per year beginning in FY-87 until completion.

The MLS program includes, at most locations, a medium-intensity approach lighting system with runway alignment indicator lights (MALSR).

The operational service test and evaluation program (STEP) will be completed using prototype equipment at several typical locations. Users will participate with airborne receivers provided by the Government. Using results from STEP, operational procedures and obstacle clearance/critical area criteria will be developed. These will include unique MLS capabilities, such as curved and segmented approaches as well as conventional approaches.

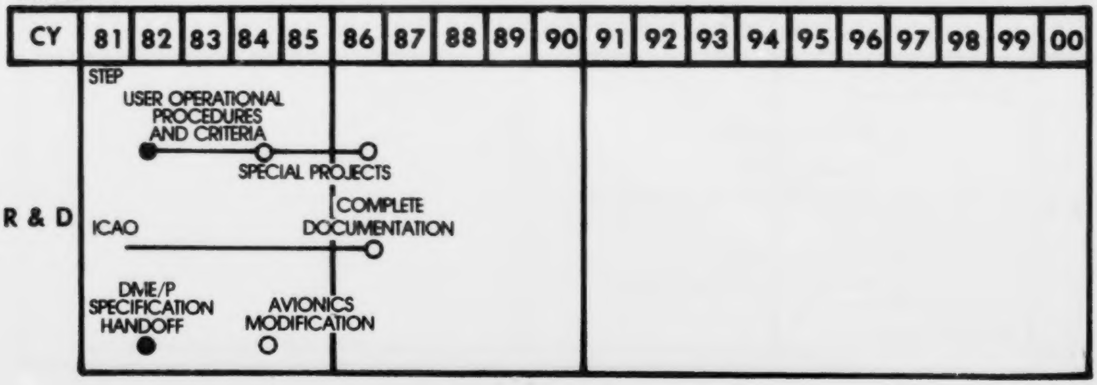
Analyses will be conducted in support of ICAO standards for such items as DME/P.

Products: 1,250 MLSs will be procured.

Related Projects/Activities: RVRs will be installed with MLSs where weather conditions meet requirements in Airway Planning Standard Number One (APS No. 1), terminal air navigation facilities, and air traffic control services. The ILSs will be decommissioned as sufficient MLSs are implemented. Some MLSs will not have MALSRs due to obstructions to the MALSR light plane or due to excessive installation costs due to terrain.

Frequency and spectrum engineering is required for MLS establishment.

SCHEDULE



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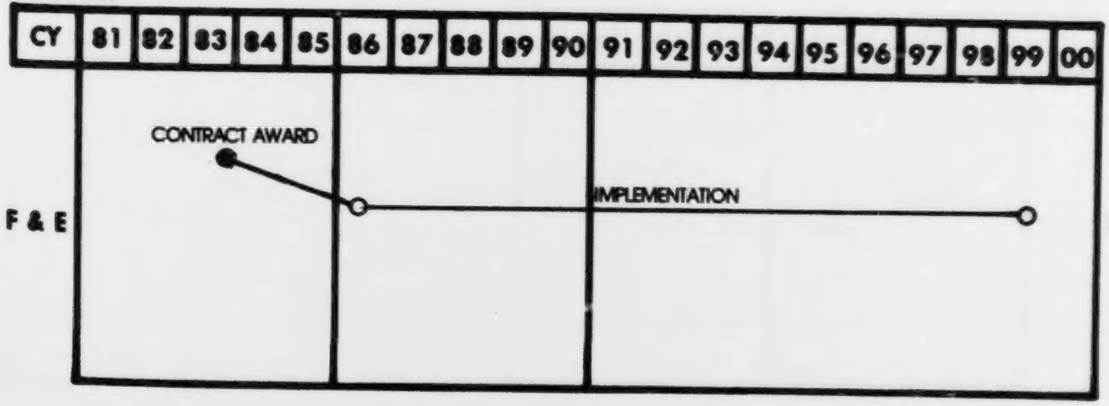
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CONTRACT AWARD
IMPLEMENTATION

PROJECT 8: Runway Visual Range (RVR)

Purpose: This project establishes runway visual range (RVR) systems on qualifying Category I ILS and MLS runways. Additionally, it provides the more precise systems required for Category IIIB runways, converts runway visibility value (RVV) systems to RVR, and replaces obsolete RVR systems.

RVR is an integral part of the precision approach system when weather conditions meet APS No. 1 requirements. RVR provides a standardized, instantaneous, and accurate method of measuring meteorological visibility on an ILS- or MLS-equipped runway. Significant changes in runway visibility will be immediately discernible and can be given to pilots of an aircraft prior to reaching the point where a decision for completion of the approach and landing must be made.

RVV equipment requires manual computation by the air traffic controller to arrive at visibility data and does not take into account such variables as runway lighting intensity. Conversion of this equipment to RVR will increase the accuracy of visibility measurements provided to the pilot and negate the need for manual computation.

Existing Tasker 400 and solid-state radiation facilities are nearing the end of their useful life. They are failure prone and manpower intensive; and replacement parts are not available.

Current RVR systems can provide visibility values as low as 600 feet. However, Category IIIB operations will require RVR readings down to 150 feet at the touchdown midpoint and rollout end of the runway.

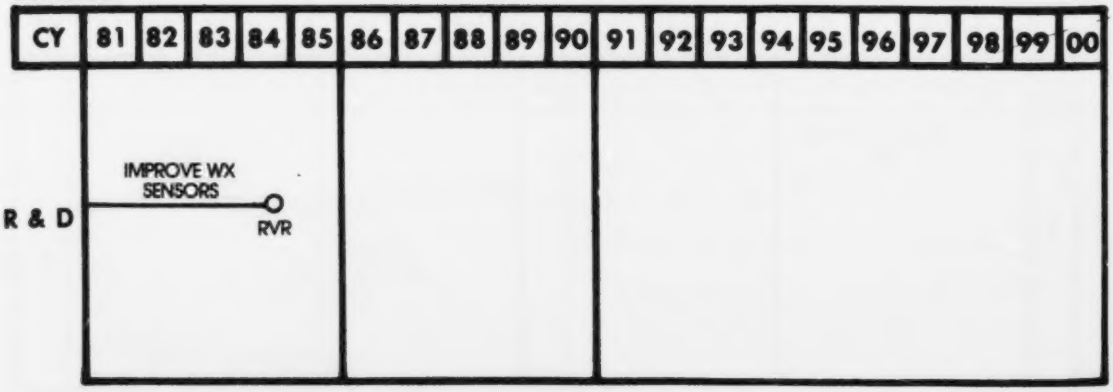
Approach: Provide equipment and funds for a multi-year program to establish new facilities, replace obsolete equipment, and meet Category IIIB requirements.

Products:

Category IIIB	37
Replace Tasker 400	90
Replace solid-state radiation	60
Replace RVV	55
Establish RVR	275 Locations

Related Projects/Activities: Establish ILS and MLS facilities. All Category II facilities require RVR; however, weather conditions must meet APS No. 1 requirements if RVR is to be installed on Category I ILS or MLS. The R&D weather-sensor improvement project may provide more reliable, less labor-intensive techniques.

SCHEDULE



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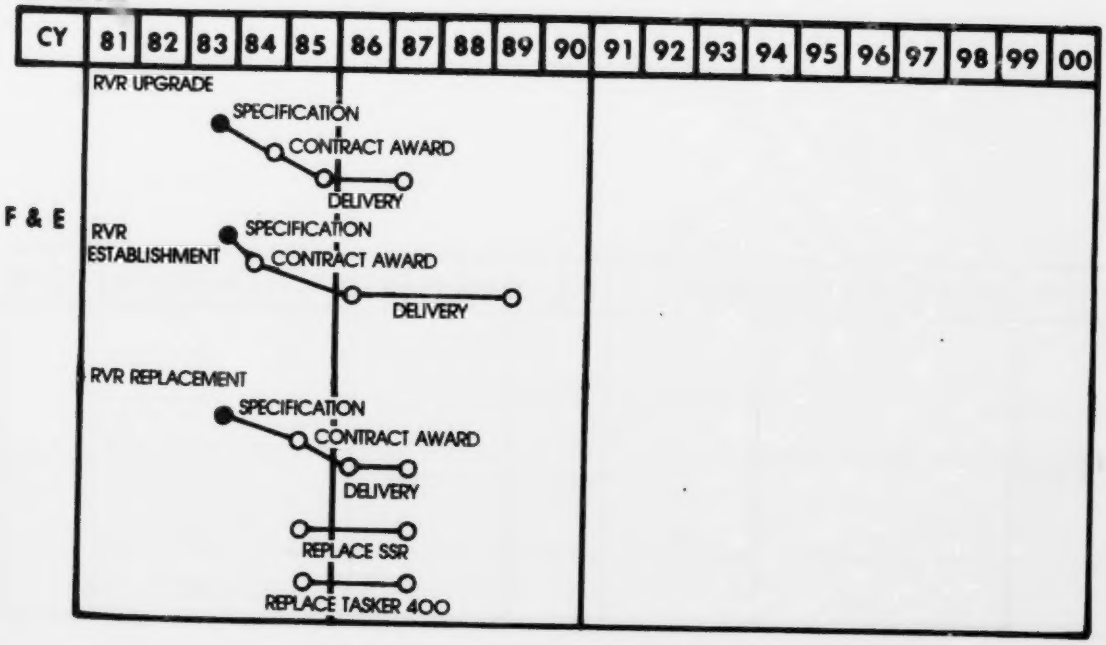
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RVR UPGRADE
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SPECIFICATION
CONTRACT AWARD
DELIVERY
REPLACE SSR
REPLACE TASKER 400

PROJECT 9: Visual Navaids

Purpose: This is an ongoing multiyear program to provide safety-related facilities and enhancements at airports. The facilities to be provided are: medium intensity approach lighting system with runway alignment indicator lights (MALSR), runway-end identification lights (REIL), visual approach slope indicator (VASI) or precision approach path indicator (PAPI), and omnidirectional airport lighting system (ODALS).

This program also includes the retrofitting of remote radio controls for visual aids to meet the operational requirements of air traffic controllers and removing complex coding requirements. The new system will permit single-button control of each visual-aid function.

The role of aviation has grown steadily in the past, and the rate of growth is expected to continue in the future. This program is based, in part, on the essential service concept expressed in the Airline Deregulation Act of 1978. It provides an equivalent level of safety to all commercially served airports and, in part, an additional level of safety at general aviation airports.

Approach: Installation is to be accomplished by regions. Washington headquarters will furnish standards and equipment. Visual and electronic navigational aid projects will be completed in conjunction with other related projects where possible.

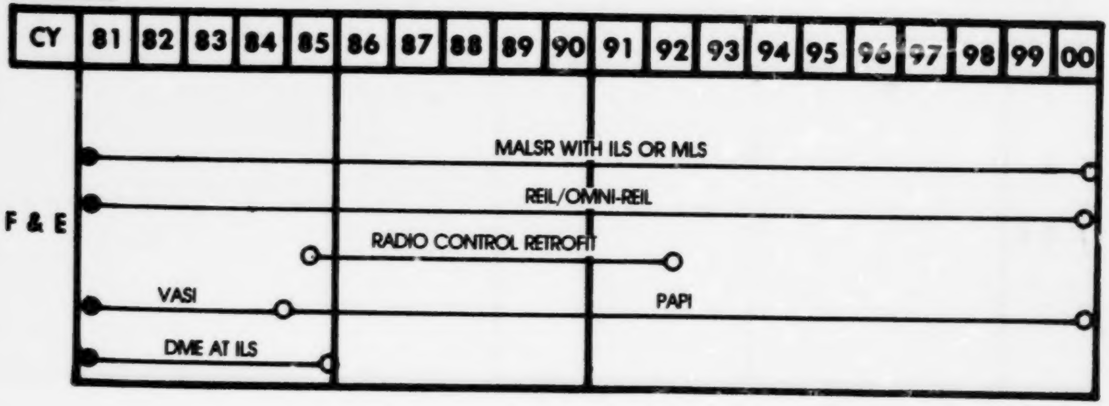
Products: Quantities vary from year to year depending upon the urgency of the requirement, validation of requirements, and availability of funds. The radio control retrofit program will involve 1,348 airports having a total of 3,032 visual aids.

Related Projects/Activities: Category I ILS and MLS establishment.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

SCHEDULE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F & E
MALSR WITH ILS OR MLS
REIL/OMNI-REIL
RADIO CONTROL RETROFIT
VASI
PAPI
DME AT ILS

PROJECT 10: Approach Lighting System Improvement Program (ALSIP)

Purpose: This is a multiyear program to retrofit existing airport runway approach lighting systems with low-impact resistant approach light supports and other improvements. The intent is to bring approach lighting systems, built before 1975, up to current standards for new installations.

Replacement of the existing rigid tower structures with light-weight and low-impact resistant structures that collapse or break apart upon impact will reduce damage to an aircraft should it strike an approach light tower structure during departure or landing. This should help reduce the severity of approach and landing accidents. This effort was mandated by FAA Order 1811.4, System Requirements Statement/Acquisition Authorization for the Approach Lighting System Program, signed by the Administrator on June 12, 1979, in response to an NTSB recommendation. The program will also result in a significant reduction in FAA energy consumption and the replacement of outdated and obsolete equipment.

Federal air regulations authorize a pilot to descend below the published minimum descent altitude or decision height providing visual references, such as approach lights, threshold lights, etc., for the intended runway are distinguishable.The installation of threshold light bars as part of the existing medium-intensity approach light system with runway alignment indicator lights (MALSR) system will provide a visual reference to the runway threshold and make the present system more effective in low-visibility conditions. The modification will enhance safety and comply with ICAO minimum requirements.

Approach: In the interest of energy conservation, high-intensity approach lighting systems with sequence flashers, Categories II and III runway configurations, are to be switchable to the simplified short-approach lighting system with sequence flashers when visibility conditions permit. The simplified short-approach lighting system configuration uses less than half the lights of the full high-intensity approach lighting system. In addition, the program will retrofit nonfrangible high-intensity approach lighting system on Category I runways with medium-intensity approach lighting system with sequence flashers. When the program is fully implemented, energy consumption of these systems will have been reduced by 60 percent over FAA FY-76 base year requirements; and approach lighting systems will be of two standard types: ALSF 2 and MALSR.

Products:

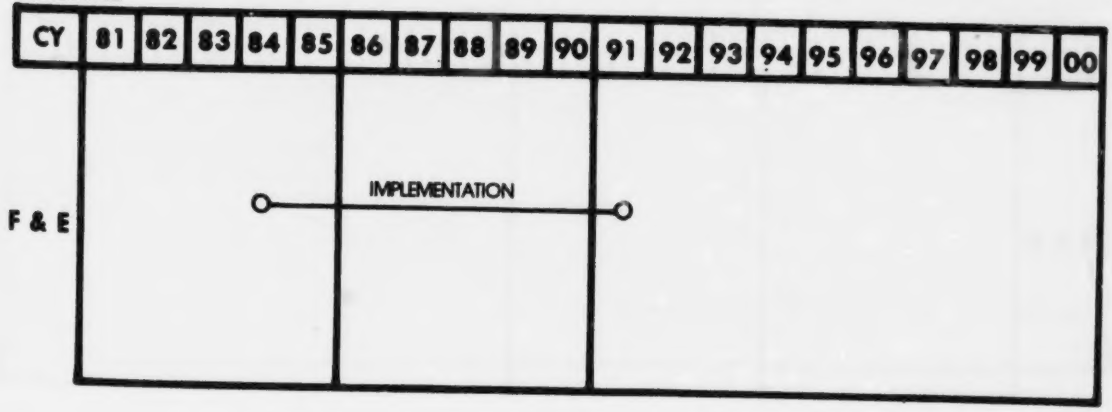
- 205 SSALF, SSALR, and ALSF 1 systems will be converted to MALSR.
- 68 ALSF 2's will be provided with low-impact resistant structures and the capability to switch to SSALR configuration.
- 182 MALSRs will be placed on low-impact resistant structures.
- 384 existing MALSRs will be provided with threshold lights.

Related Projects/Activities: ILS and MLS. All new MALSRs installed will have low-impact resistant structures and threshold lights.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

SCHEDULE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IMPLEMENTATION

PROJECT 11: Direction Finder (DF)

Purpose: The purpose of this project is to upgrade existing direction finder (DF) systems with solid-state equipment and to establish sites for additional coverage. Additionally, remote indicators will be relocated within selected FSS or AFSS control facilities to increase operational efficiency.

The replacement of the existing tube-type DF system with solid-state equipment will result in cost savings and cost avoidance by reducing power consumption and maintenance requirements.

Approach: The existing tube-type DF equipment will be replaced with new solid-state equipment which has remote maintenance monitoring, control, and certification capabilities.

In areas where present DF equipment does not provide complete coverage, new sites will be established and co-located with existing FAA facilities (such as VOR/DME). Indicators will be relocated and remoted to positions within FSS facilities to make each system readily accessible to operational personnel.

The preliminary regional network studies indicate that some additional DFs will be required; however, studies are not final. For planning purposes, a preliminary estimate of 350 facilities is being used.

Products:

	1981-1985	1986-1990	1991-2000
Establish DF	125	50	
Disaster Replacement	5	5	10
Relocate DF Indicator	60		
Replace DF		175	
Co-locate DF			350

TOTALS BY TARGET YEAR

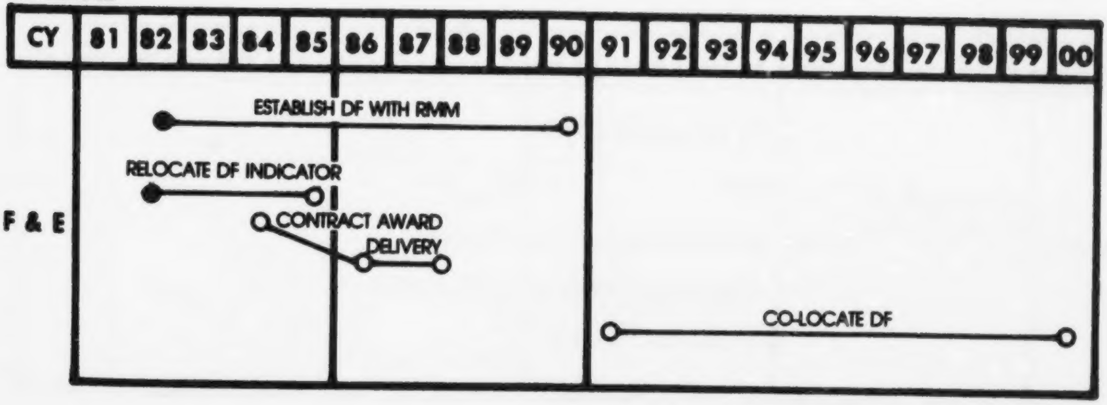
	1981	1985	1990	2000
DF	175	300	350	350

Related Projects/Activities: The DF network plan will be coordinated with VORTAC and communication network plans to determine where DFs can be co-located with VOR/DME, RMLs, VORTACs, and RCFs and be RMM compatible. FAA's national telecommunications network may be used for remoting to AFSS.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

SCHEDULE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ESTABLISH DF WITH RMM
RELOCATE DF INDICATOR
CONTRACT AWARD
DELIVERY
CO-LOCATE DF

PROJECT 12: Mode S/Data Link

Purpose: This project will improve the surveillance capability of the air traffic control radar beacon system (ATCRBS). Mode S provides more accurate positional information and eliminates interference. This is accomplished by discrete interrogation of each aircraft and improved processing of aircraft replies.

In addition Mode S provides the medium for a digital data link which will be used to exchange information between the aircraft and various ATC functions and weather data bases.

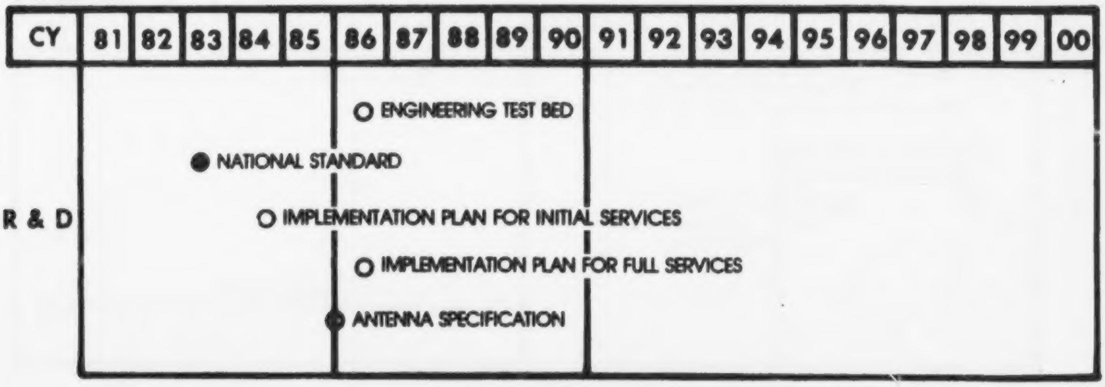
Approach: Required Mode S systems will be procured using multiple contracts. The first contract for 137 systems will provide coverage down to 12,500 feet above mean sea level (msl) and to the ground at high-density terminals. The second contract for an additional 60 systems will extend this coverage down to 6,000 feet msl. The systems are designed to be remote maintenance monitored and unmanned. Existing ATCRBS antennas not already capable of improved azimuth resolution will be replaced and/or additional antennas procured where increased data rates are required.

Potential Mode S/data link services will be developed and tested using the Mode S engineering test bed at the Technical Center which will consist of a Mode S ground system and a number of transponders and related airborne input and display equipment.

Initial data link service will consist of weather products available from existing weather data bases. Subsequent data link services will also include data and functions which will originate from the advanced automation system.

Additional testing and development will be conducted to determine the applicability of extending the Mode S surveillance and data link capabilities to other functions.

SCHEDULE



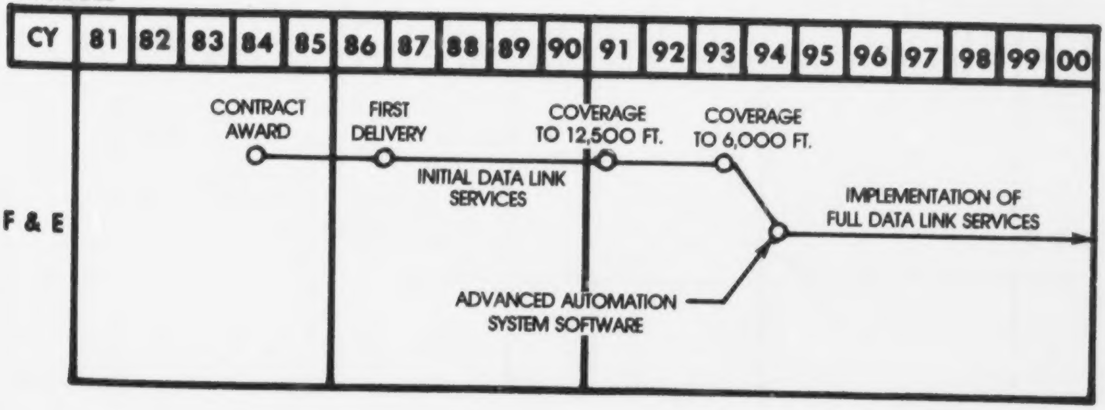
Products:

- Mode S systems at a maximum production capability of 48 per year.
- Engineering test bed.
- Mode S/data link national aviation standard.
- Implementation plan for initial data link services.
- Implementation plan for data link services.
- Specification for Mode S antenna for long-range radars.
- Long-range radar back-to-back monopulse antennas.

Related Projects/Activities:

- The traffic alert and collision avoidance system (TCAS) utilizes Mode S data format and frequencies.
- Long-range and terminal radar programs, as well as en route and terminal ATC automation activities, will be coordinated with plans for Mode S implementation to assure compatibility of digital message formats.
- FAA telecommunication network will provide the communications medium for data link services between Mode S and the various sources of data and advisories.
- Mode S will be an RMM system.
- AAS software will take advantage of the capabilities of Mode S/data link.

SCHEDULE



PROJECT 13: Terminal Radar (ASR) Program

Purpose: This project will continue to economically provide radar service at airports with air traffic densities high enough to justify the service and to upgrade the highest density airports with the latest state-of-the-art equipment.

Replacement of the ASR 4/5/6 is necessary because of the decreasing availability of spare parts and the high-maintenance workload. Repair parts availability for the ASR 4/5/6 radars will be critical by 1989.

Approach: Three separate activities have been combined to form this program.

- Replacement of 96 ASR 4/5/6 vacuum-tube radars with ASR 7/8/9 (leapfrog 16 ASR 7 to ASR 4/5/6 sites, leapfrog 40 ASR 8 to ASR 4/5/6, and install 40 ASR 9's at ASR 4/5/6 sites).

- Procurement of ASR 9 systems to provide radar service at airports where the air traffic volume increases to a level requiring the coverage.

- Relocation of existing solid-state radars (ASR 7/8) as new construction interferes with required radar coverage and changes in air traffic volume make it necessary.

Estimates for replacement of 96 ASR 4/5/6's do not include replacing existing buildings or transferring to new locations.

Data from ASR 9 radars will be remoted in digital format only. At the indicator site the data will be available in digital and analog format.

Products:

- Replace 96 radars.

- Establish the minimum number of additional radars.

- Relocate 56 radars by 1990.

Related Projects/Activities:

- ASR 9 installations at operational sites are planned to precede Mode S installations and must be coordinated.

- Frequency and spectrum engineering is involved with the Terminal Radar, Long-Range Radar, and Weather Radar Programs since these systems compete for pulse repetition frequency (prf) assignments in the same frequency bands.

- Changes to ARTS IIIA software will not be required to accept ASR 9 digital data.

- ASR 7/8 facilities will require digitizing in a format compatible with the common radar network.

- Automation facilities and sensor sites will be consolidated in a coordinated manner with en route and terminal automation replacements and consolidation.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
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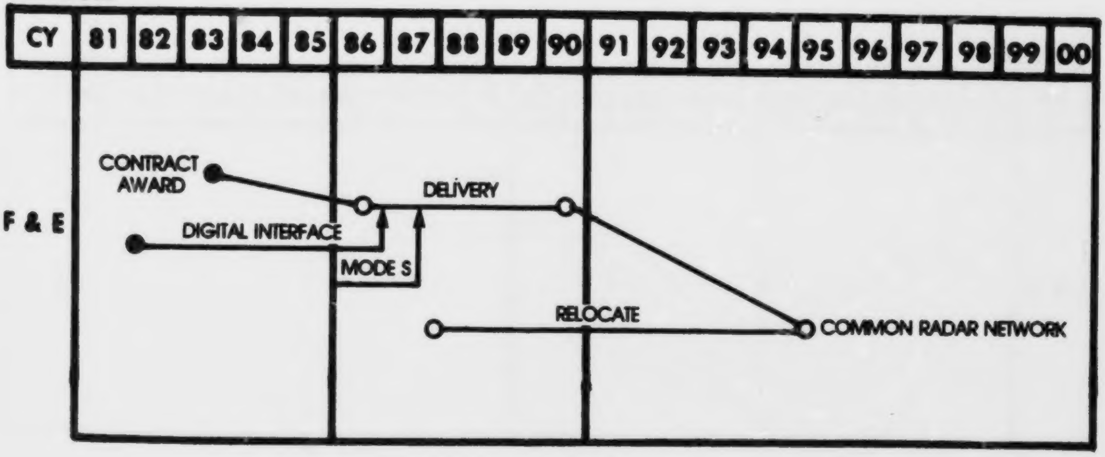
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CONTRACT AWARD
DIGITAL INTERFACE
DELIVERY
MODE S
RELOCATE
COMMON RADAR NETWORK

PROJECT 14: Airport Surface Detection Equipment (ASDE 3) Radar

Purpose: This project will provide for the surveillance of aircraft and airport service vehicles on the airport surface proper in all weather conditions.

At high-activity airports, radar monitoring of airport surface operations (ground movements of aircraft and other supporting vehicles) is required to maintain aircraft separation and provide an effective and expeditious means of directing and moving surface traffic. This is especially important during periods of low visibility such as rain, fog, and night operations.

Approach: A specification will be developed which details a ground surveillance radar that will map the airport complex and identify airplane or service equipment locations and movement. A contract award is anticipated in 1985.

The ASDE antenna will be located on top of the airport traffic control tower (ATCT) which may require some minor structural modifications. New installations will require structural modifications to the existing ATCT or possibly a separate remote tower.

Products: Deliveries are planned starting in calendar year 1988 with the last system delivery in 1991. Current requirement is for the establishment of 17 systems (includes FAA Academy) and for the replacement of 12 systems.

Related Projects/Activities: None.

SCHEDULE

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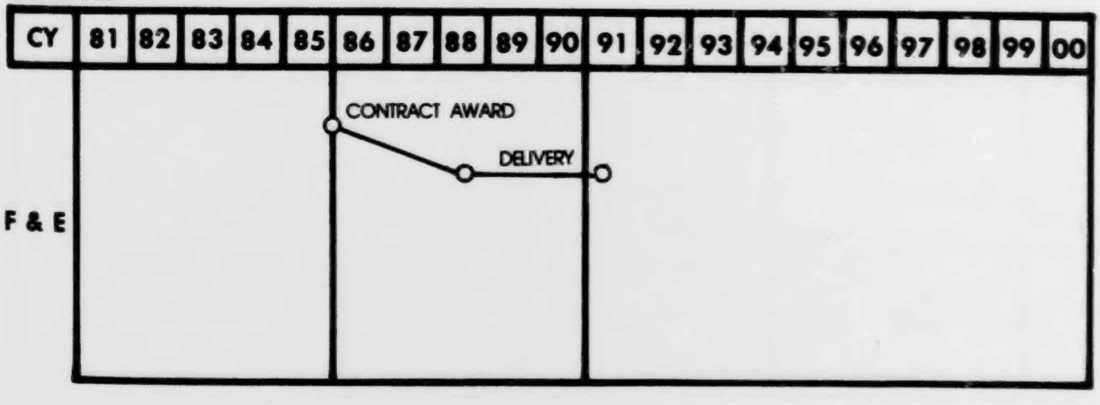
R & D																				

SCHEDULE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PROJECT 15: Long-Range Radar Program

Purpose: This project will provide a national surveillance network and replace, upgrade, or decommission systems requiring excessive maintenance and periodic visits.

It is essential that accurate and timely data on the presence and movements of aircraft transiting the en route ATC environment be continuously available to the en route ATC system so that maximum use can be safely afforded to all users of the airspace. This data can be made available by radar surveillance information.

This replacement/upgrade program will significantly reduce maintenance workload and logistics costs, as well as resolve problems relating to nonavailability of spare parts for the existing old radars. By using selected terminal radar for both terminal and en route surveillance, en route ATC service can be accomplished with fewer radar facilities.

Approach: Selected portions of vacuum-tube radars will be replaced with solid-state devices. Repair and refurbish other portions and improve tolerance to power fluctuations. Provide limited remote control. These steps are necessary to extend the usable life of the vacuum tube-type radars until the national network can be implemented. RMM will be provided for all ARSR 3 facilities.

Expand the joint use of military radars to supplement existing coverage. Undertake a joint FAA/USAF procurement of 3-D radars to replace all joint surveillance systems (JSS). Relocate ARSR 3 JSS equipment to the west.

Integrate terminal radars into an overall surveillance network upon availability of advanced automation system software. This will require the installation of additional terminal-type radars (such as the ASR 9) as gap fillers and will allow the decommissioning of all vacuum-tube radars and the relocation of the remaining ARSR 3 equipment. ASR 7/8 systems utilized in the network will receive modified common digitizers made surplus by the JSS replacement.

Products:

- 47 three-dimensional radars (plus 1 for training).
- 23 ARSR 3 relocations.
- Remote data from 34 existing terminal radars.
- Establish 23 ASR 9 gap fillers.

Related Projects/Activities: Remote monitoring and control, Mode S, Advanced Automation System, ASR 9, CD replacement, ASR remoting. Frequency and spectrum engineering is involved with the Terminal Radar, Long-Range Radar, and Weather Radar Programs since these systems compete for prf assignments in the same frequency bands.

SCHEDULE

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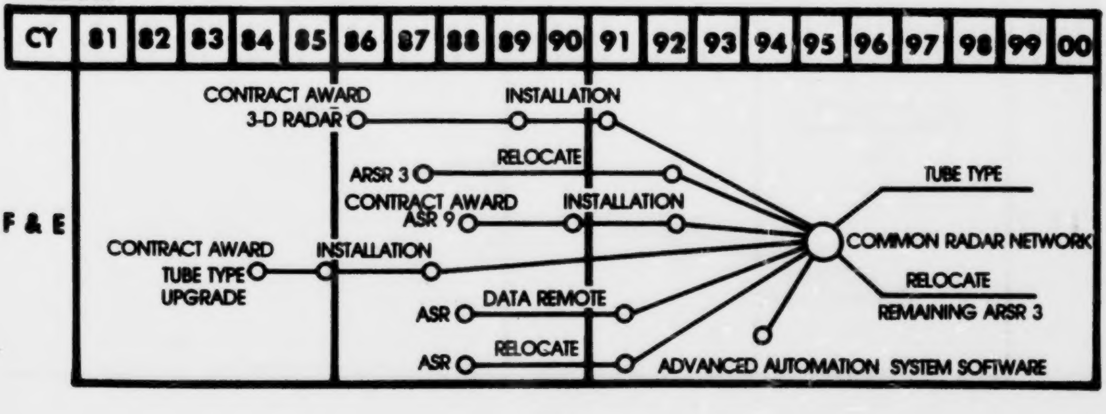
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COMMON RADAR NETWORK
RELOCATE
REMAINING ARSR 3
ADVANCED AUTOMATION SYSTEM SOFTWARE

PROJECT 16: Weather Radar Program

Purpose: This project will establish an aviation weather radar network that will provide accurate aviation weather products (precipitation reflectivity, wind velocity, and turbulence indicators). It will also furnish software algorithms to take advantage of the improved radar presentation of weather data.

Radar weather presentations available from today's systems are not adequate for air traffic control. Inadequate and unreliable data results in inaccurate weather forecasts which contribute to aircraft weather-related accidents and the selection of nonfuel-efficient routes. In addition to the improvements to be gained in today's system, future automated ATC functions such as AERA and improved flow management must have reliable and accurate weather data before maximum fuel efficiency and manpower productivity gains projected for these improvements can be realized.

Approach: This program consists of the definition, development, procurement, and installation of a new Doppler weather radar for en route applications. The long-range Doppler weather radar for en route applications, known as the next generation weather radar (NEXRAD), is being funded jointly by the Department of Commerce (60 percent), the Department of Defense (20 percent), and the FAA (20 percent).

An initial procurement of 10 NEXRAD units will be followed by a production procurement. The number of NEXRAD units and the mix of NEXRAD and conventional weather radars will be determined by DOC, DOD, and FAA.

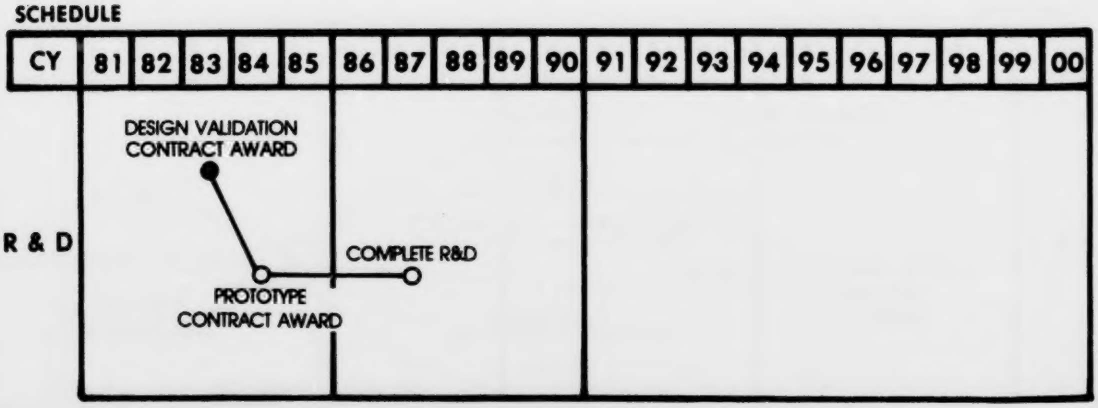
Products:

- NEXRAD

—CONUS Network—(joint purchase with FAA, National Weather Service, and Air Weather Service)	up to 113
—FAA non-CONUS	11
—USAF	44

Related Projects/Activities: Long-range radar replacement program, Advanced Automation System, terminal radar replacement program, CWP, and leased communications. (These activities are concerned with establishing the network and upgrading the ATC radars. The data developed will be provided to the central weather processor for dissemination.)

Frequency and spectrum engineering is involved with the Terminal Radar, Long-Range Radar, and Weather Radar Programs since these systems compete for prf assignments in the same frequency band.



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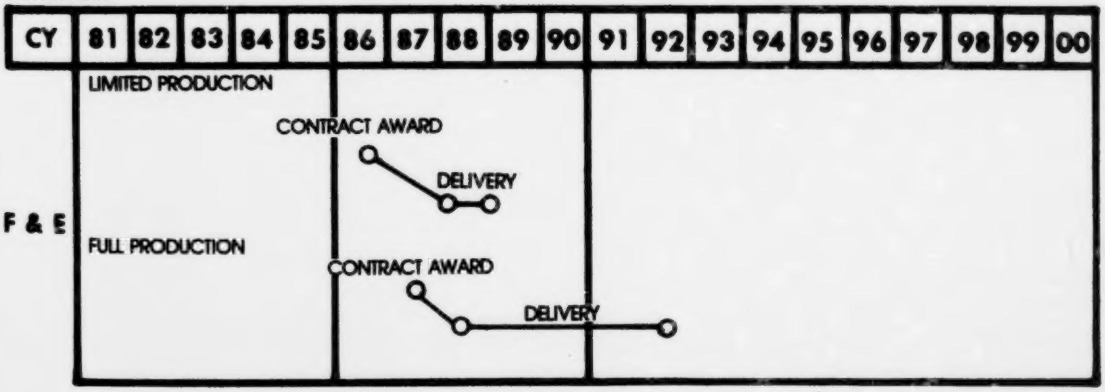
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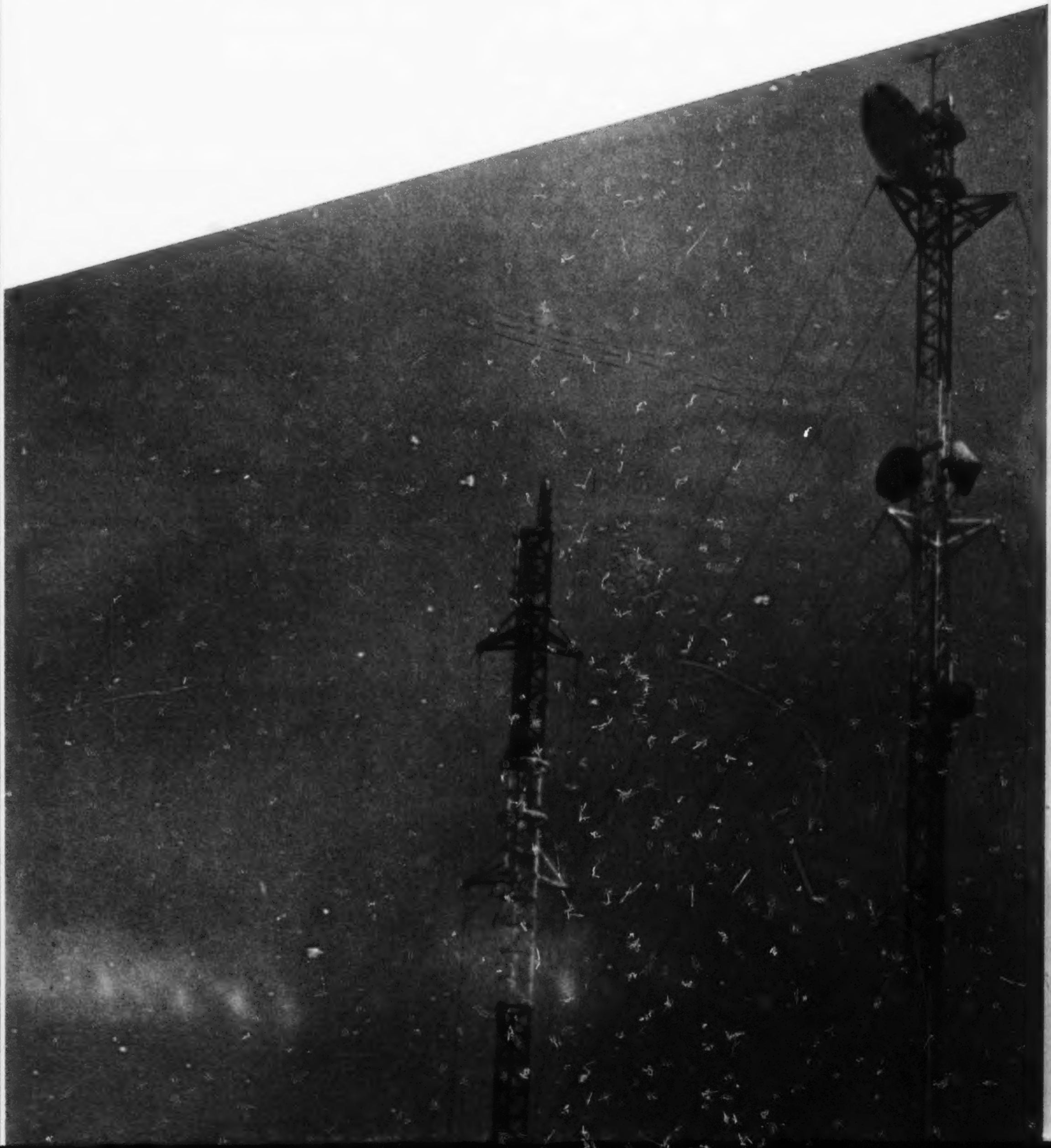
CHAPTER V

INTERFACILITY COMMUNICATIONS SYSTEMS



INTERFACILITY COMMUNICATIONS SYSTEMS

Interfacility communications systems provide communications between FAA facilities, including major manned facilities, such as air route traffic control centers, airport traffic control towers, and smaller remote facilities such as radar sites and ground-to-air radio sites.

Although most interfacility services used for both voice and data transmission are currently leased, some are FAA-owned. Most FAA-owned transmission media are radar microwave link (RML) equipment. RMLs are used to send en route radar information to appropriate air route traffic control centers. These links also are used for backup emergency communications (BUEC), ground-to-air receivers and transmitters, and limited other applications. These RMLs span about 16,000 miles.

The FAA also owns television microwave links (TML) which are used to remote radar information to tower BRITE displays at one or more satellite airports. They also can be used to remote data across an airport where it is too expensive to lay cable.

Most transmission media are leased, generally from local utility companies. Low-speed teletypewriter networks emanate from the Kansas City, Missouri, National Communications Center (NATCOM). These networks distribute a variety of aviation-related national and international information. Typical functions performed by these networks include the distribution of flight plan information (Service B), weather information (Services A and C), and international messages (aeronautical fixed telecommunications network (AFTN)). Often, multiple terminals are co-located in the same facility. Network interconnections also are provided to other countries, the National Weather Service, and other users, such as airlines.

Most data circuits are low-speed (150 bits-per-second or less) subvoice-grade lines. Little interoperability exists on these circuits. Medium-speed lines (2400 bits-per-second) are used to connect newer equipment, such as computers. Very few high-speed circuits exist or are required until functions are consolidated.

Voice circuits generally are leased, private lines between major facilities or between major facilities and remote facilities. In addition to voice applications, they are used for monitoring and control of transmitters, receivers, and navigational aids.

THE NEW APPROACH

The current interfacility system has evolved piece by piece as requirements dictated. Circuit costs were low, and the ability to provide services was generally limited to public utility communications companies. Over the years, however, common carrier telecommunications rates have escalated and are expected to continue to do so. Recently, competition has emerged in almost all telecommunications areas. Opportunities are now available for the FAA to take a systems approach to its interfacility communication needs and to develop a network which will provide greater reliability through alternate routing capabilities, flexibility, and growth potential, while constraining operating costs.

An integrated network, the NAS interfacility communications system (NICS), will be established to replace the current fragmented systems. This new approach will result in better and expanded service to air traffic control and other users at a lower cost.

The basic approach is to establish, over the next 5-8 years, a versatile communications utility which can provide the necessary variety of voice and data transmission and switching systems for all other systems in this Plan. Because communications is essential to the operation of these systems, this utility must evolve and become operational before the systems it serves. Services required include pure transmission of both voice and data (between major facilities and remote facilities) and voice and data switching services primarily between major facilities. Transmission services include the necessary patching and switching to permit service restoral in the event of partial system failures. This system will evolve in a way which permits it to satisfy our current and near-term requirements as well as the long-range requirements of the late 1980's and 1990's. A number of projects have been defined which, when individually completed and integrated, will result in the NAS interfacility communications system. These projects are described in this chapter and in chapter III.

HOW THE SYSTEM WILL EVOLVE

NEAR TERM (TO 1985)

Activities are already underway to upgrade system performance with emphasis on containing costs and providing a step toward the NAS interfacility communications system. These activities provide for the development of a firm foundation for subsequent network establishment.

A cost-savings project was initiated in 1981 to replace all teletypewriter grade lines and teletypewriter equipment in Alaska where maintenance and leased-line costs are most severe. Outdated equipment has been replaced with higher speed, multiplexed services and state-of-the-art terminals. This service is fully leased. It has increased leased services costs by $400,000 per year, but it has led to the abolishment of 30 maintenance positions. Also, it has eliminated the need to buy expensive replacement parts for the 25-year-old, low-reliability teletypewriter equipment.

This system was expanded into the lower 48 in 1982 and will be expanded again in 1984 through the teletypewriter replacement project.

Since the initial FAA computer modems were installed, methods of data transmission have improved significantly. FAA will lower costs by procuring high-speed multiplexing modems and using higher speed circuits to replace multiple medium-speed circuits.

FAA-owned RMLs, used for special purpose communications, have appreciable spare capacity. By adding certain equipment, it is possible to use these links as trunks for general-purpose communications. For example, a long leased line could be replaced by a channel within an RML system and two local, or tail, circuits. In the near term, FAA will use this highly cost-effective method as the backbone of an FAA transmission network.

The FAA has begun to establish a National Data Interchange Network (NADIN). By 1985, NADIN will form the nucleus of an FAA switched data network. NADIN will provide greater capability to switch messages throughout the network and replace multiple, low-speed lines and switches with concentrators, switches, and high-speed lines. In addition to improving flexibility, NADIN will save several million dollars annually in leased- line costs. The NADIN buildings will allow the eventual relocation of NATCOM computers, reducing leased services costs and facility overhead.

A number of management-related actions are underway to improve interfacility communications services at lower costs. The FAA is examining its total management information system needs and will create an information system which will provide better cost tracking, accountability, and flexibility in ordering leased service. A systems support contractor has evaluated all interfacility communication needs and has defined basic system interconnections and equipment needed.

INTERMEDIATE TERM (TO 1990)

There will be significant changes as the FAA communications system evolves into a comprehensive integrated network. A key element of this evolution is the network design. The network design accommodates NADIN expansion, RML expansion, satellite trunking, and network management.

The NADIN system will evolve into a general-purpose, data transmission system with alternate routing capabilities to bypass failed or saturated areas. It will be the nucleus of the FAA switched data telecommunications system.

Multiplexing will continue and allow facilities requiring access to the switched network to do so in a cost-effective manner. It will eliminate a large percentage of dedicated or individual lines. Multiplexed circuits will be used to connect multiple remote points to the network's backbone.

Many multiplexed tails or spur lines will terminate at such facilities as airport traffic control towers where multiple, low-speed systems (for items such as weather observation, surveillance, etc.) will exist.

During the intermediate term, transmission media will likely be a mix of satellites, leased circuits, and radio links. Current analysis indicates that it is cost-effective to upgrade and expand the FAA's RMLs for general interfacility use. As shown on the maps, radar RMLs can be converted to a suitable configuration for many backbone and tail circuit uses. Cost performance of satellite transmission, however, is improving; and for long-distance, high-density communications, satellites will probably be more cost-effective. Satellites may also be used to back up the FAA transmission system in the event of catastrophic failure or extended outages of a primary communications node. Thus, toward the end of the period, some new mix of satellite, FAA-owned, and leased transmission is likely.

A network management system will be implemented during this time frame to provide restoral functions and management of the network. Initially, the system will use semi-automatic restoral switching with most control decisions made at the lowest level, usually at the ARTCC/ACF facility. Both NADIN and VSCS include automatic rerouting of message and voice traffic in the event of transmission system failures. A higher level of centralized network monitoring and control will be established to resolve multiple failures and/or global issues.

By 1990 new voice communications switching equipment will be installed in most facilities. This will limit leased equipment costs, provide better operational features, and allow greater flexibility in reconfiguring positions during offpeak traffic periods. VSCS will begin to provide these features for ARTCCs/ACFs; and ICSS will be used in automated flight service stations, ATCTs, and TRACONs. Additionally, new solid-state radio control equipment will be used to improve system reliability and reduce maintenance and logistics costs.

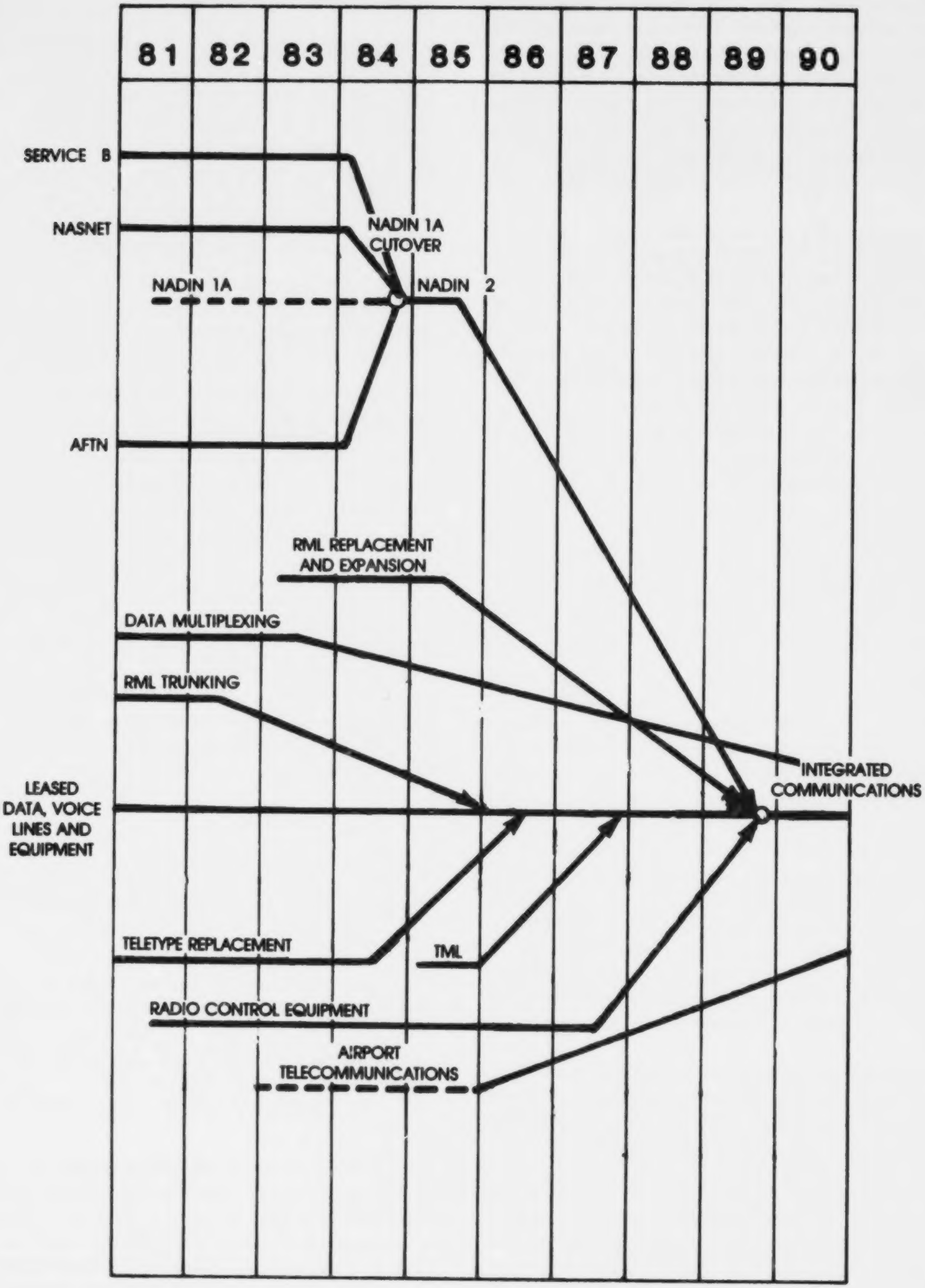
By accomplishing the above, a comprehensive communications network will be established. It will encompass satellite links, RML backbone, tail circuits, local area, and switching and control equipment. It will be designed so that facility consolidation and activities requiring cost-effective communication can be readily supported.

LONG TERM (TO 2000)

In the long term, facility consolidation and new services such as Mode S/data link and automated en route air traffic control (AERA) impose increasing interfacility requirements. The comprehensive network will accommodate these requirements. The appropriate technologies (including satellites) will be used. VSCS will be completed and a new tower communications switching system will evolve through applying VSCS technology to the tower switching systems.

Network control and monitoring will be automated at one or more centralized locations. This will maintain the global system configuration at optimum capacity and efficiency and reduce system restoral times.

The following diagram and maps describe the evolution of the system.


81
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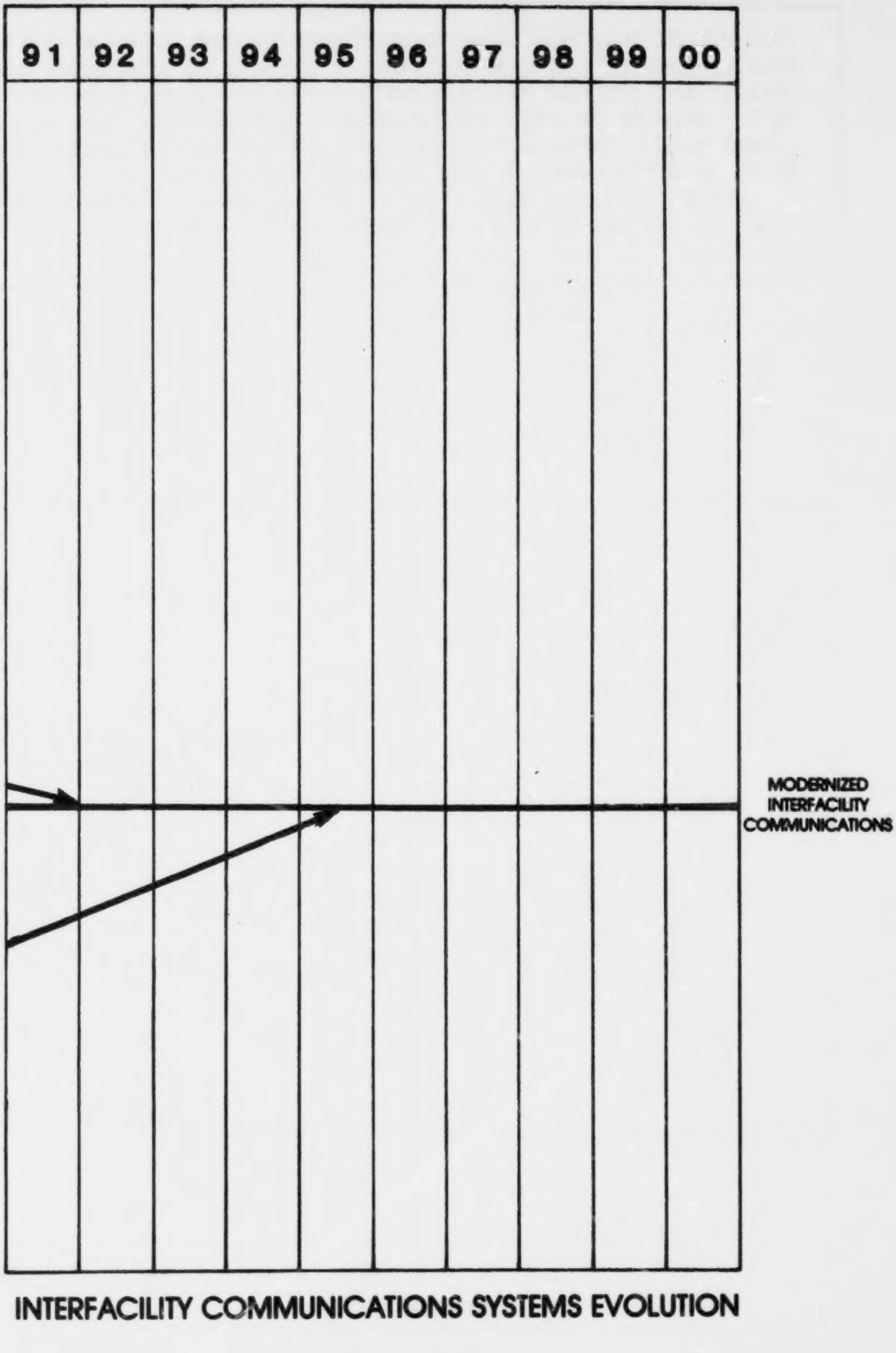
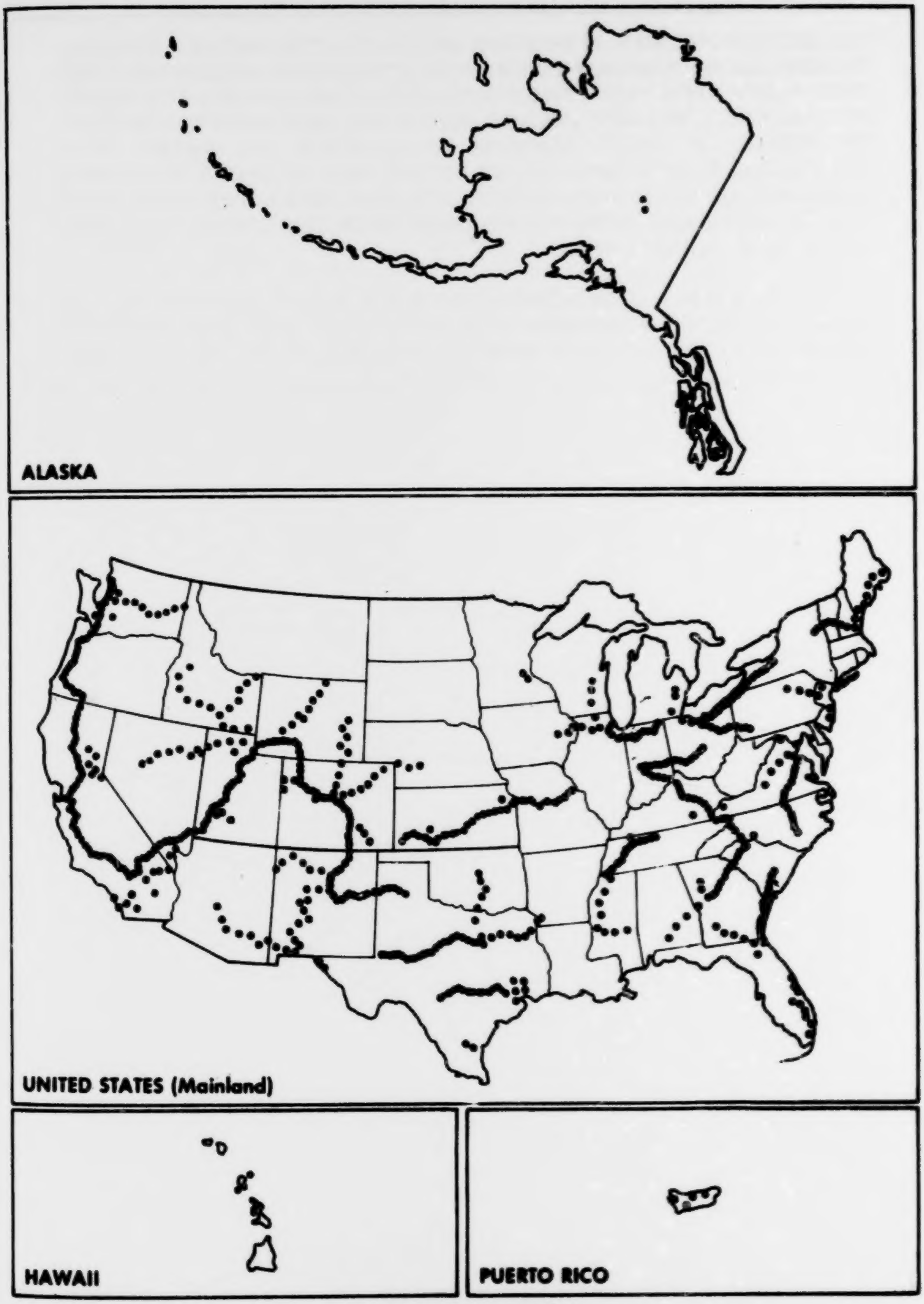
88
89
90
SERVICE B
NASNET
NADIN 1A CUTOVER
NADIN 1A
NADIN 2
AFTN
RML REPLACEMENT AND EXPANSION
DATA MULTIPLEXING
RML TRUNKING
INTEGRATED COMMUNICATIONS
LEASED DATA, VOICE LINES AND EQUIPMENT
TELETYPE REPLACEMENT
TML
RADIO CONTROL EQUIPMENT
AIRPORT TELECOMMUNICATIONS



INTERFACILITY COMMUNICATIONS SYSTEMS EVOLUTION

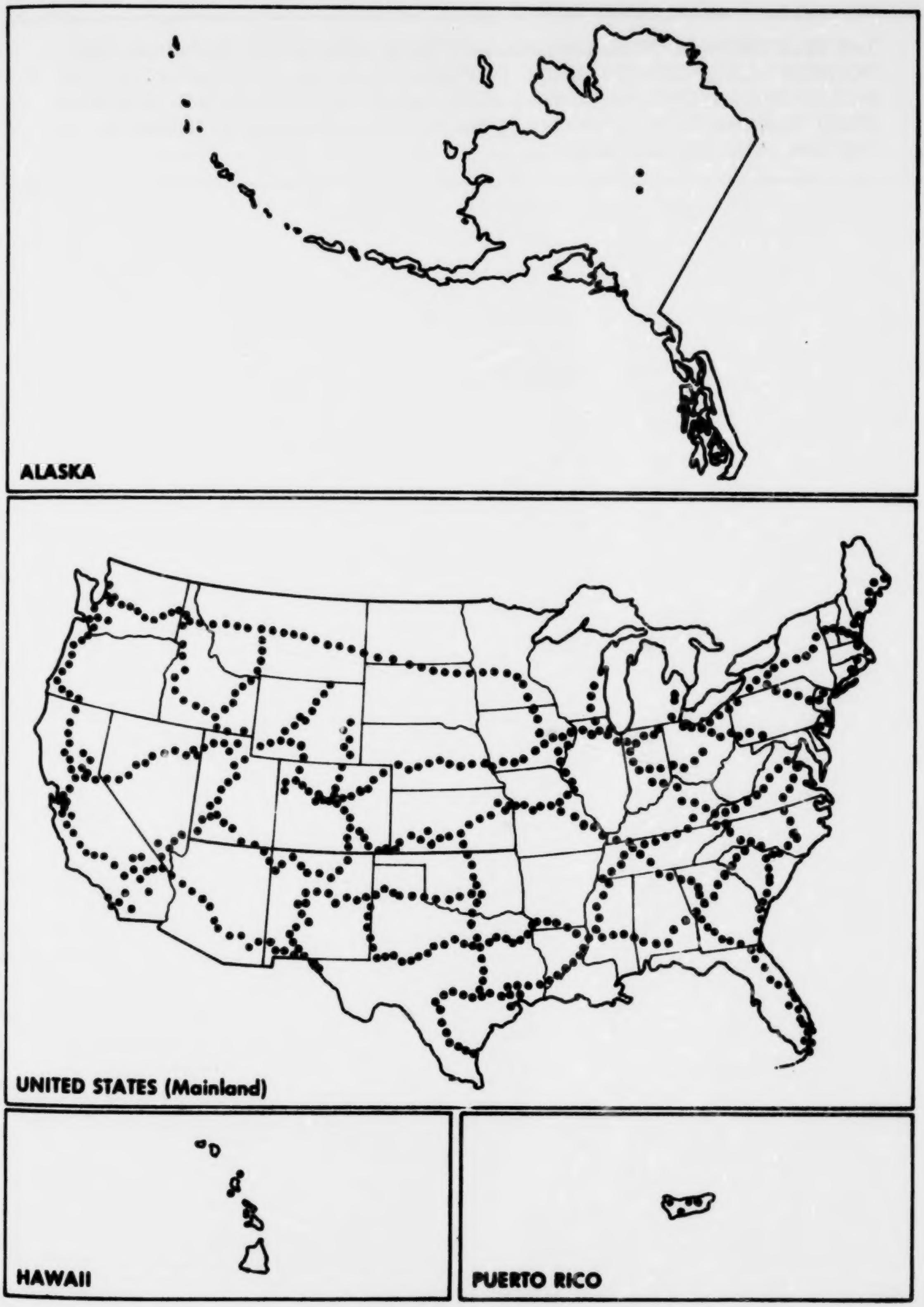
THIS MAP DEPICTS THE RADAR MICROWAVE LINK (RML) SYSTEM AS IT CURRENTLY EXISTS. THE RML PROVIDES A MEDIUM TO TRANSFER RADAR BROADBAND AND NARROWBAND DATA TO THE ARTCCs FROM THE REMOTE SITE. ADDITION OF DATA MULTIPLEXING EQUIPMENT BY 1985 REDUCES LEASED-LINED COSTS. SYSTEMS (PATHS) DESIGNATED FOR REPLACEMENT BY FY-85 ARE SHOWN WITH HEAVY CONTINUOUS LINES. THE SYSTEM WILL FORM THE INITIAL "BACKBONE" RML VOICE AND DATA TRANSMISSION SYSTEM TO REDUCE LEASED COMMUNICATIONS COSTS AND IMPROVE RELIABILITY.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1981-1985 SYSTEM
RADAR MICROWAVE LINK

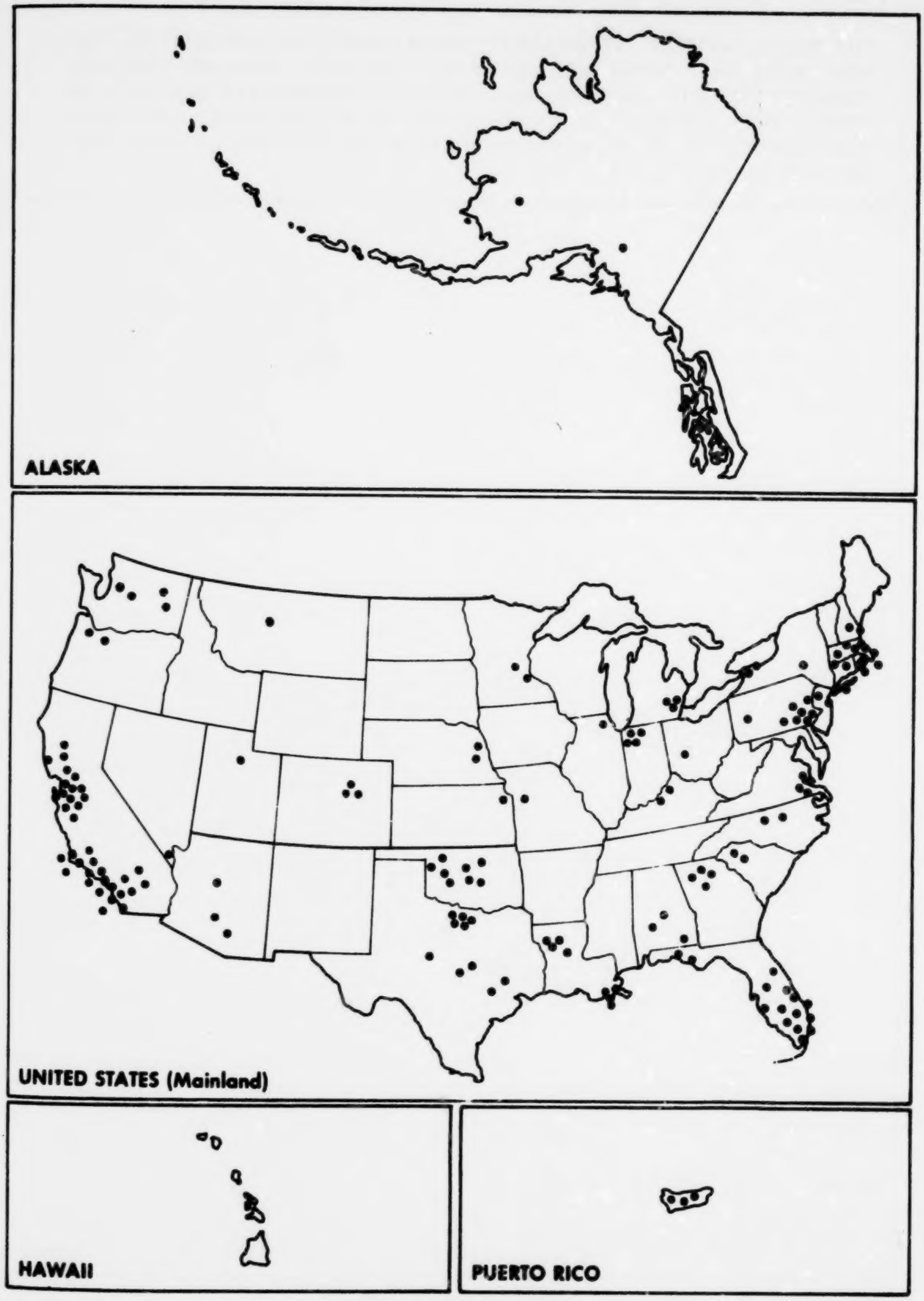
FAA MICROWAVE LINKS AT THIS TIME WILL BE FUNCTIONING AS A GENERAL TRANSMISSION TRUNKING MEDIUM RATHER THAN BEING USED PURELY FOR SPECIALIZED RADAR REMOTING FUNCTIONS. AFTER SUITABLE COST/BENEFIT ANALYSIS, LINKS (RETAINED OR ADDED) WILL BE COMPRISED OF HIGHER POWER (1 WATT MINIMUM) SOLID-STATE EQUIPMENT WITH MULTIPLEXERS. DETERMINATION AS TO WHETHER TO UPGRADE EXISTING LINKS AND ADD ADDITIONAL ONES WILL BE MADE ON A LINK-BY-LINK BASIS AND BE DEPENDENT UPON THE REQUIRED NETWORK CONNECTIVITY AND COSTS OF ALTERNATE MEDIA.

BY THE YEAR 2000, FAA MICROWAVE LINKS, IN PLACE AT THIS TIME, WILL BE USED FOR TRUNK TRANSMISSION OF BOTH VOICE AND DATA BETWEEN MAJOR FACILITIES AND FROM REMOTE FACILITIES TO MAJOR FACILITIES.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

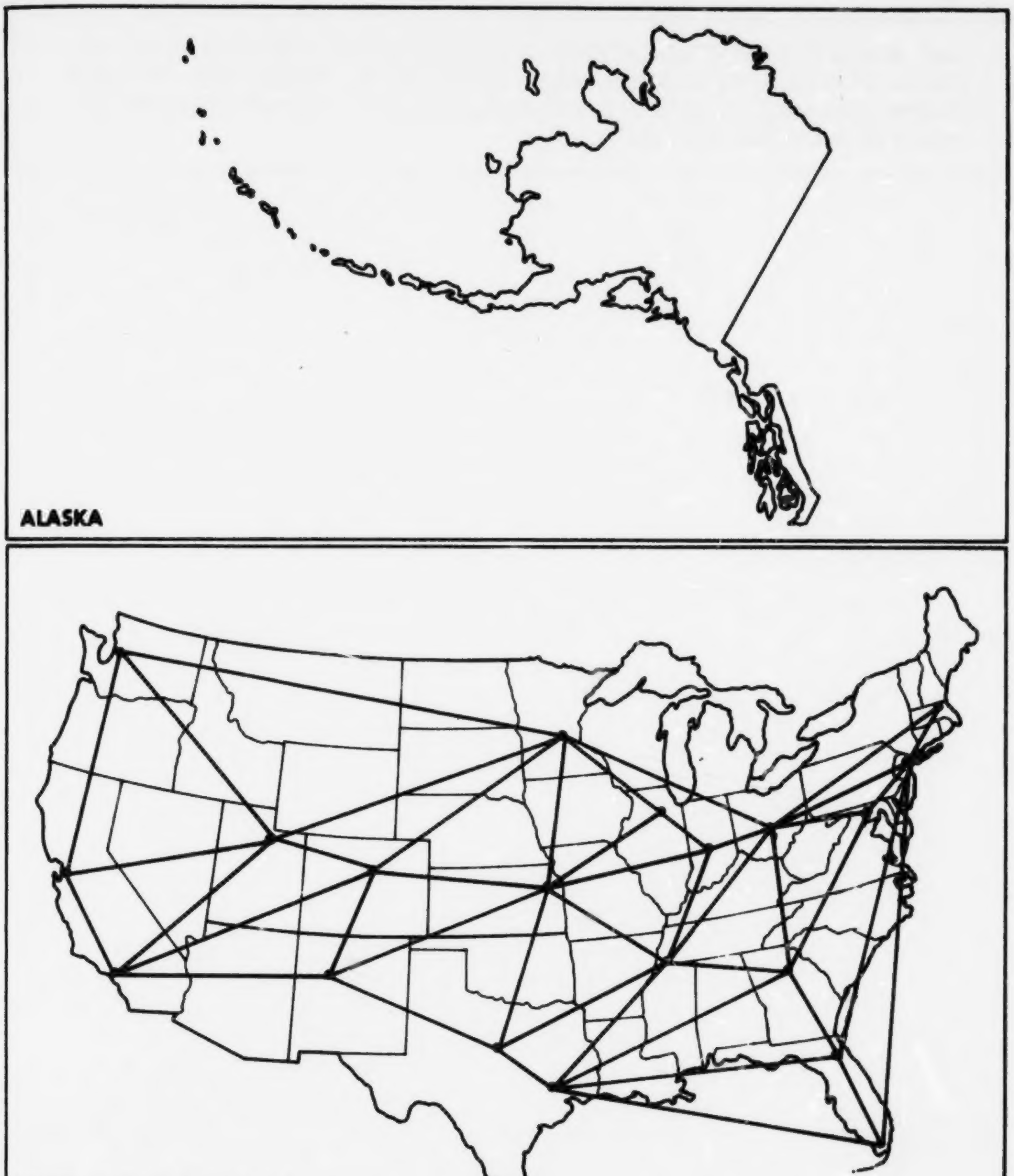
1990-2000 SYSTEM
RADAR MICROWAVE LINK

THE TELEVISION MICROWAVE LINK SYSTEM IS USED IN THE TERMINAL ENVIRONMENT FOR REMOTING BRITE TV VIDEO TO SATELLITE TOWERS. IN THE NAS OF THE FUTURE, THESE WILL ALSO CARRY VOICE AND DATA CIRCUITS FROM TOWERS TO AREA CONTROL FACILITIES AND FORM EXTENSIONS TO THE RML "BACKBONE" SYSTEM.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

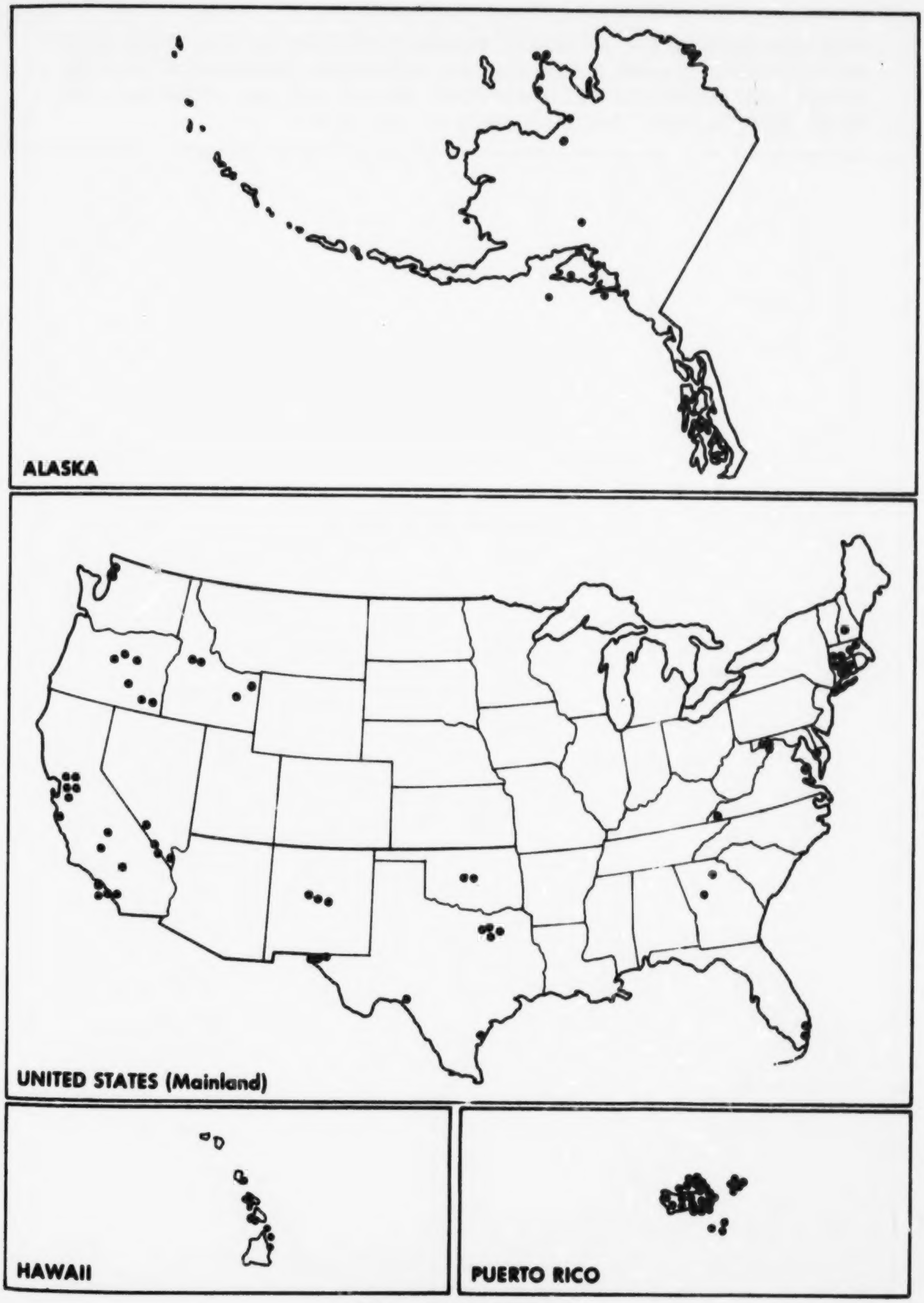
1981-1985 SYSTEM
TELEVISION MICROWAVE LINK

THE 9020 COMPUTER INTERFACILITY DATA LINES ARE DEPICTED ON THIS MAP. NOTE THAT THESE ARE POINT-TO-POINT LINES WITH NO THROUGH CONNECTIVITY (I.E., OAKLAND 9020 CANNOT COMMUNICATE DIRECTLY TO DENVER 9020). 9020's ARE ALSO CONNECTED TO ALL ARTS FACILITIES. FDIO/ FDEP CONNECTIVITY IS ALSO PROVIDED TO ATCTs. HOWEVER, THESE LINES ARE NOT SHOWN FOR CLARITY.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

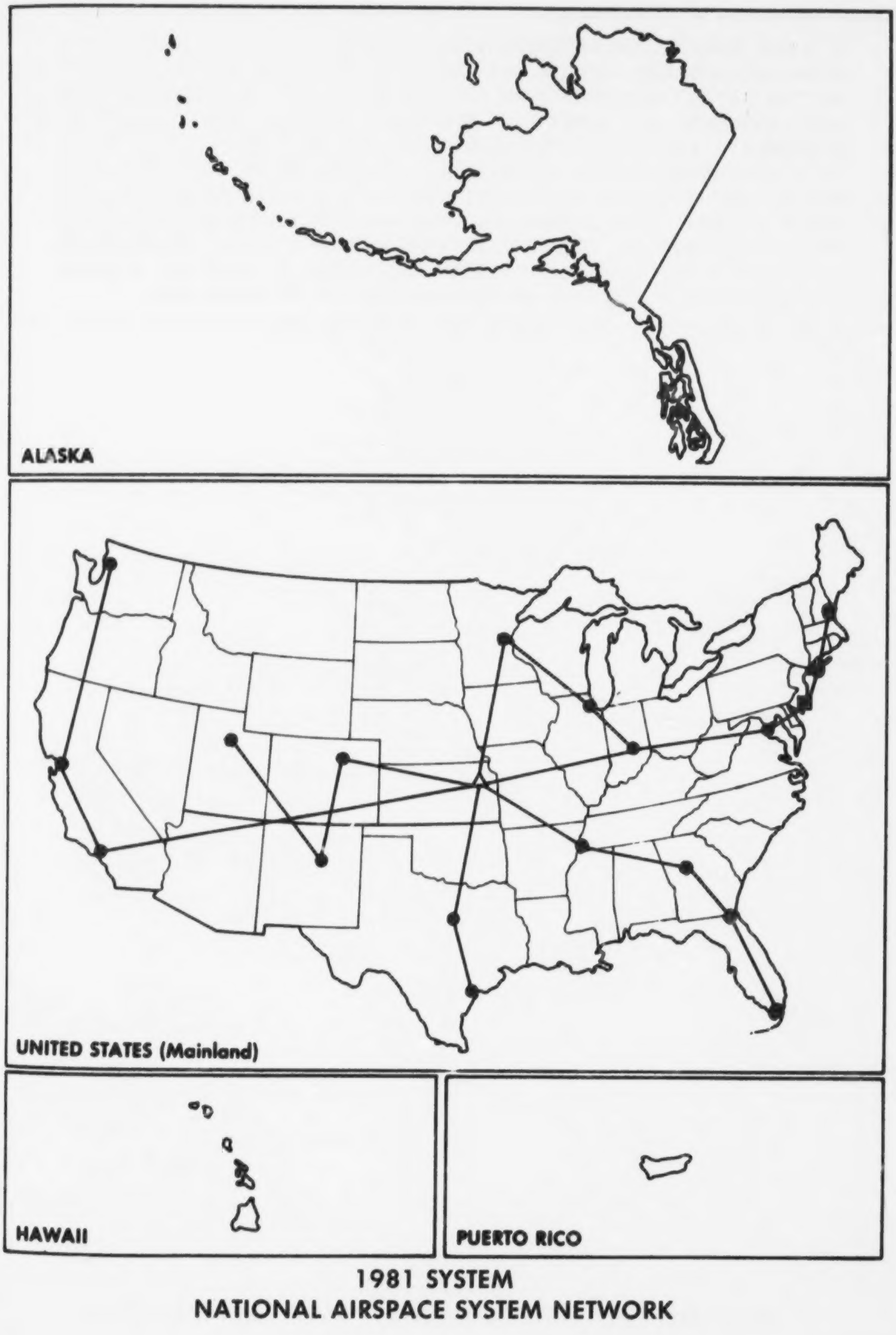
1981-1985 SYSTEM
NAS/NAS INTERFACILITY

THIS MAP DEPICTS THE LOCATIONS OF UHF/VHF LINKS USED FOR REMOTING VOICE, CONTROL FUNCTIONS, AND RADAR DATA. THESE ARE UTILIZED WHERE DISTANCE AND PATH FADE POTENTIAL DICTATE FREQUENCIES BELOW THE MICROWAVE BAND.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

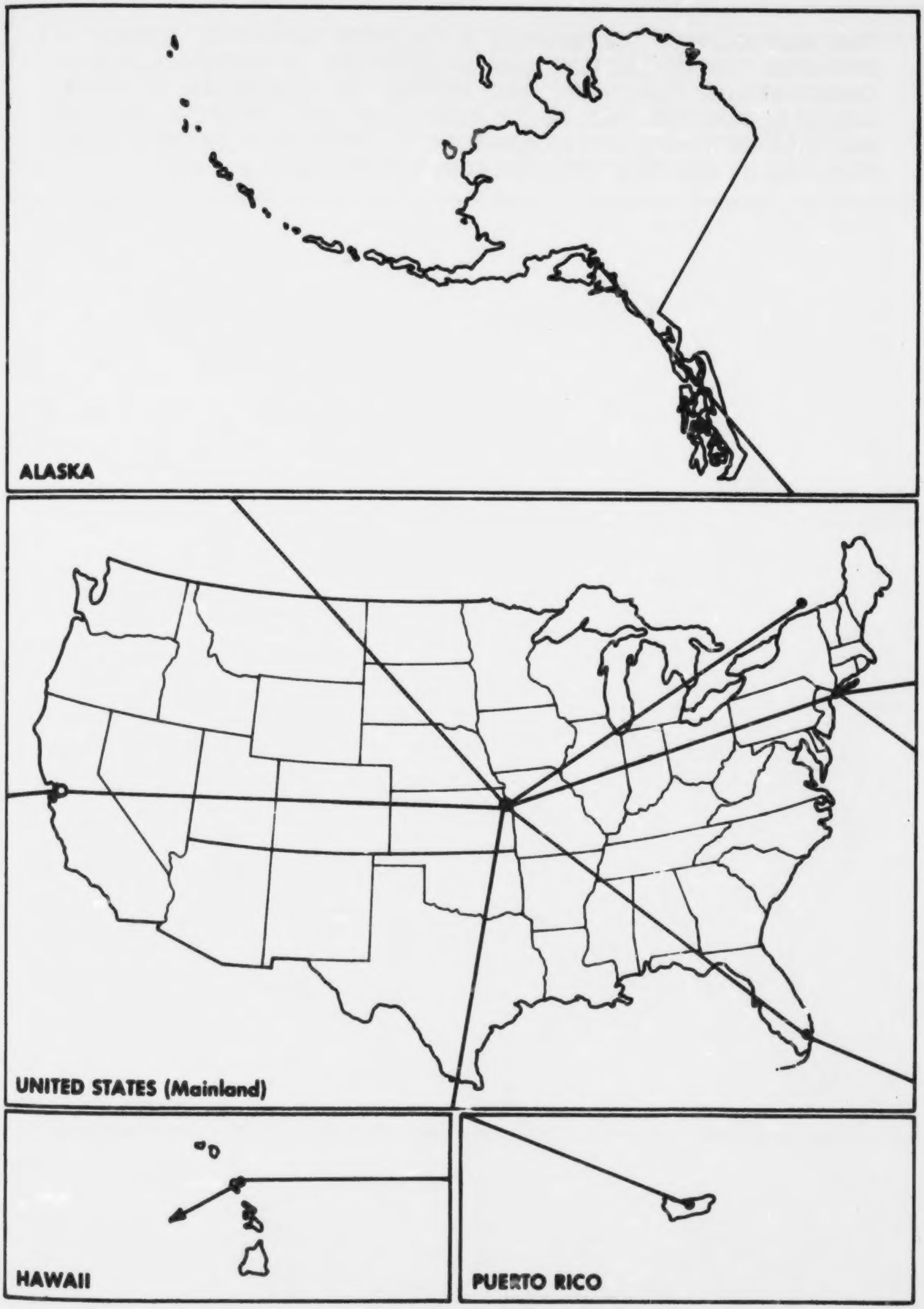
1981-1985 SYSTEM
UHF/VHF LINK INTERFACILITY

THIS MAP DEPICTS THE NATIONAL AIRSPACE SYSTEM NETWORK (NASNET) WHICH PROVIDES ADMINISTRATION AND TECHNICAL COMMUNICATIONS BETWEEN THE NATIONAL FIELD SUPPORT GROUP AND ALL REGIONAL OFFICES, ARTCCs, AND SELECTED ARTS III FACILITIES.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

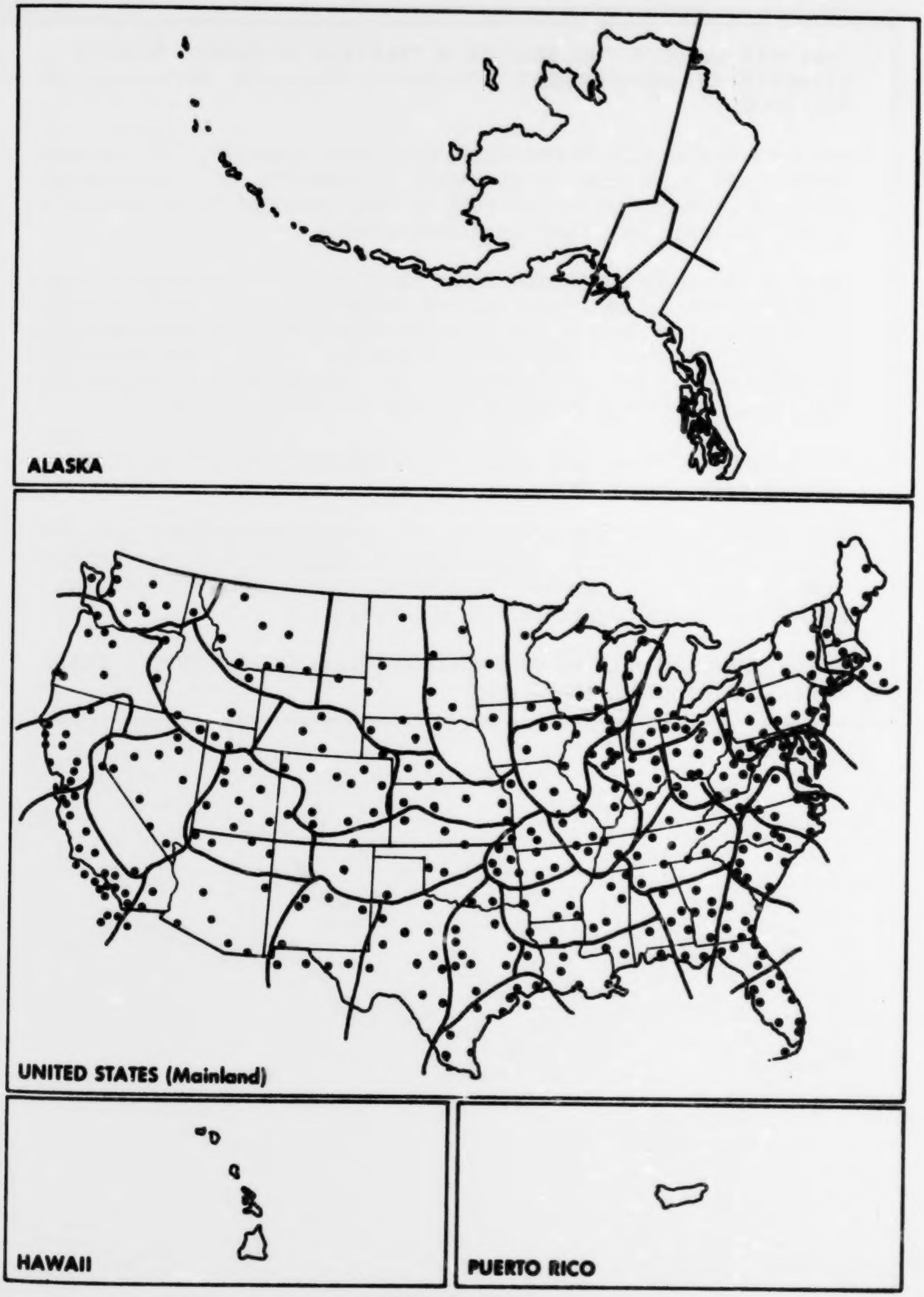
1981 SYSTEM
NATIONAL AIRSPACE SYSTEM NETWORK

THIS MAP DEPICTS THE AERONAUTICAL FIXED TELECOMMUNICATIONS NETWORK (AFTN) IN 1981. AFTN IS AN INTEGRATED WORLDWIDE SYSTEM MEETING THE DATA COMMUNICATIONS REQUIREMENTS OF THE INTERNATIONAL CIVIL AVIATION COMMUNITY. IT PROVIDES INTERNATIONAL AIRCRAFT MOVEMENTS, ADMINISTRATIVE MESSAGES, AND METEOROLOGICAL DATA BETWEEN THE UNITED STATES AND ICAO NATIONS. THE PRESENT AFTN FOR WHICH FAA HAS RESPONSIBILITY IS DIVIDED INTO TWO MAJOR AREAS—THE NORTH ATLANTIC AND CARIBBEAN AREA AND THE ALASKAN AND PACIFIC AREA. SWITCHING AND RELAY FUNCTIONS FOR AFTN ARE ACCOMPLISHED BY MESSAGE SWITCHING EQUIPMENT INSTALLED AT NATCOM, KANSAS CITY, MISSOURI. THESE WILL BE REPLACED BY NADIN 1A IN 1985.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1981 SYSTEM
AERONAUTICAL FIXED TELECOMMUNICATIONS NETWORK

THIS MAP DEPICTS THE SERVICE A TELETYPE NETWORK. SERVICE A PROVIDES FOR COLLECTION AND DISTRIBUTION OF METEOROLOGICAL OBSERVATIONS, FORECASTS, AND NOTAMs VIA LOW-SPEED TELETYPE CIRCUITS. CONTROL AND RELAY FUNCTIONS ARE PROVIDED BY THE WEATHER SWITCHING CENTER, KANSAS CITY, MISSOURI. SERVICES WILL BE PROVIDED BY THE TELETYPE REPLACEMENT PROGRAM BY 1985.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1981 SYSTEM
SERVICE A TELETYPE NETWORK

THIS MAP DEPICTS THE SERVICE B TELETYPE NETWORK. SERVICE B CONSISTS OF INDEPENDENT, LOW-SPEED TELETYPE NETWORKS AS FOLLOWS:

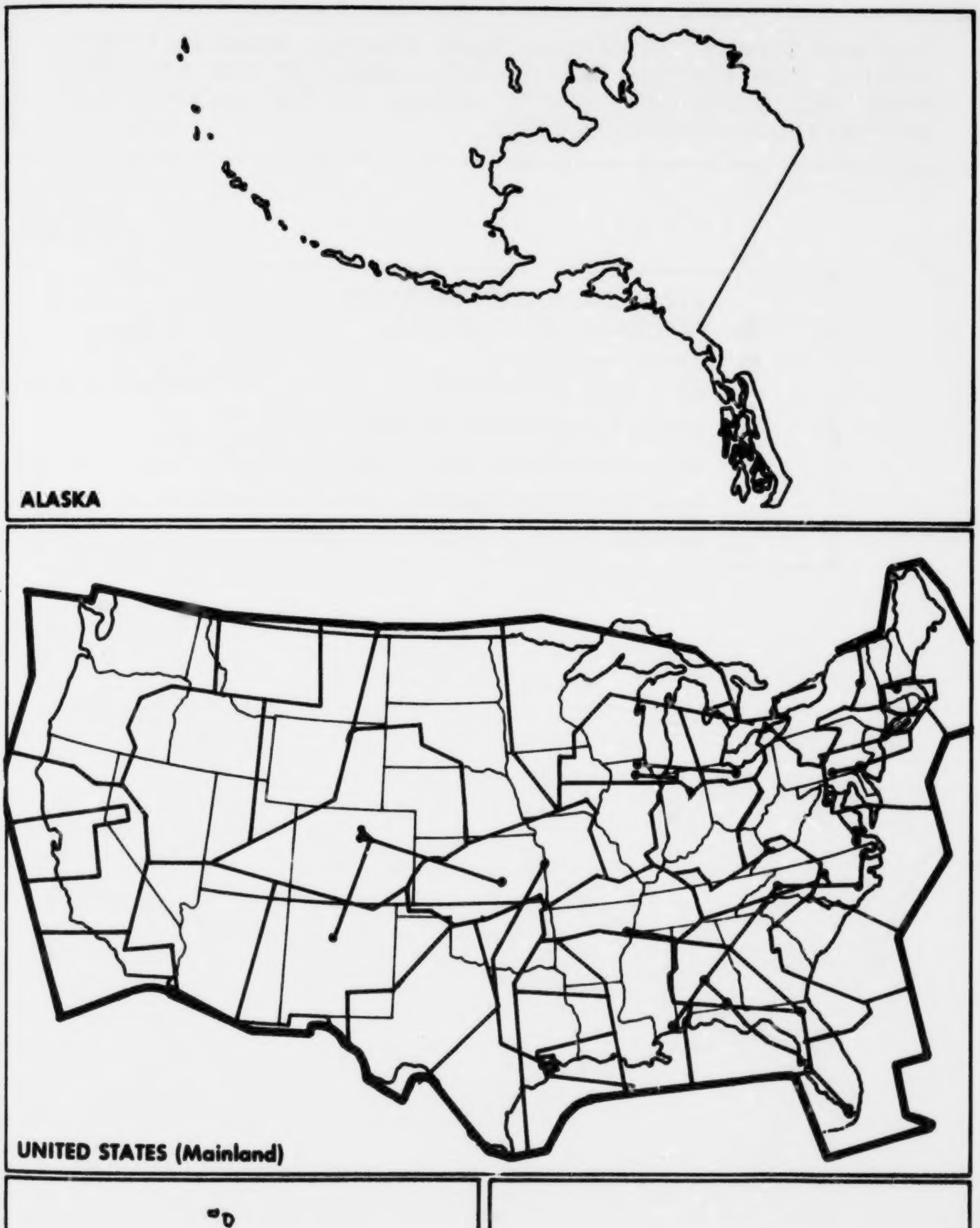
UTILITY B IS A MEANS OF PROVIDING IFR FLIGHT PLAN INPUT TO THE NAS COMPUTERS FROM REMOTE SERVICES. IT CONSISTS OF 15 MULTIPOINT CIRCUITS CONNECTING EITHER ONE OR TWO CENTERS TO AS MANY AS FOUR FSSs AND 17 MILITARY BASE OPERATIONS.

AREA B PROVIDES IFR FLIGHT PLAN INPUT TO NAS COMPUTERS FROM REMOTE SOURCES SWITCHED VIA THE ABDIS COMPUTER. AREA B ALSO TRANSFERS VFR FLIGHT PLANS BETWEEN FLIGHT SERVICE STATIONS AND TRANSMISSION OF AIRCRAFT ACCIDENT AND NOTIFICATION, INTERNATIONAL LAW ENFORCEMENT, AND ADMINISTRATIVE MESSAGES. THE AREA B NETWORK EXTENDS TO OVER 300 FAA FACILITIES.

SUPPLEMENTAL B CIRCUITS ARE PROVIDED TO OFFLOAD AREA B AT HIGH-DENSITY AREA B LOCATIONS.

THE CENTER B NETWORK CONSISTS OF NINE TELETYPEWRITER CIRCUITS CONNECTING ALL ARTCCs, HEADQUARTERS COMMUNICATIONS CONTROL CENTER, AND ATCCC. CENTER B IS USED FOR FLOW CONTROL EMERGENCY AND IFR MOVEMENT AND CONTROL MESSAGES.

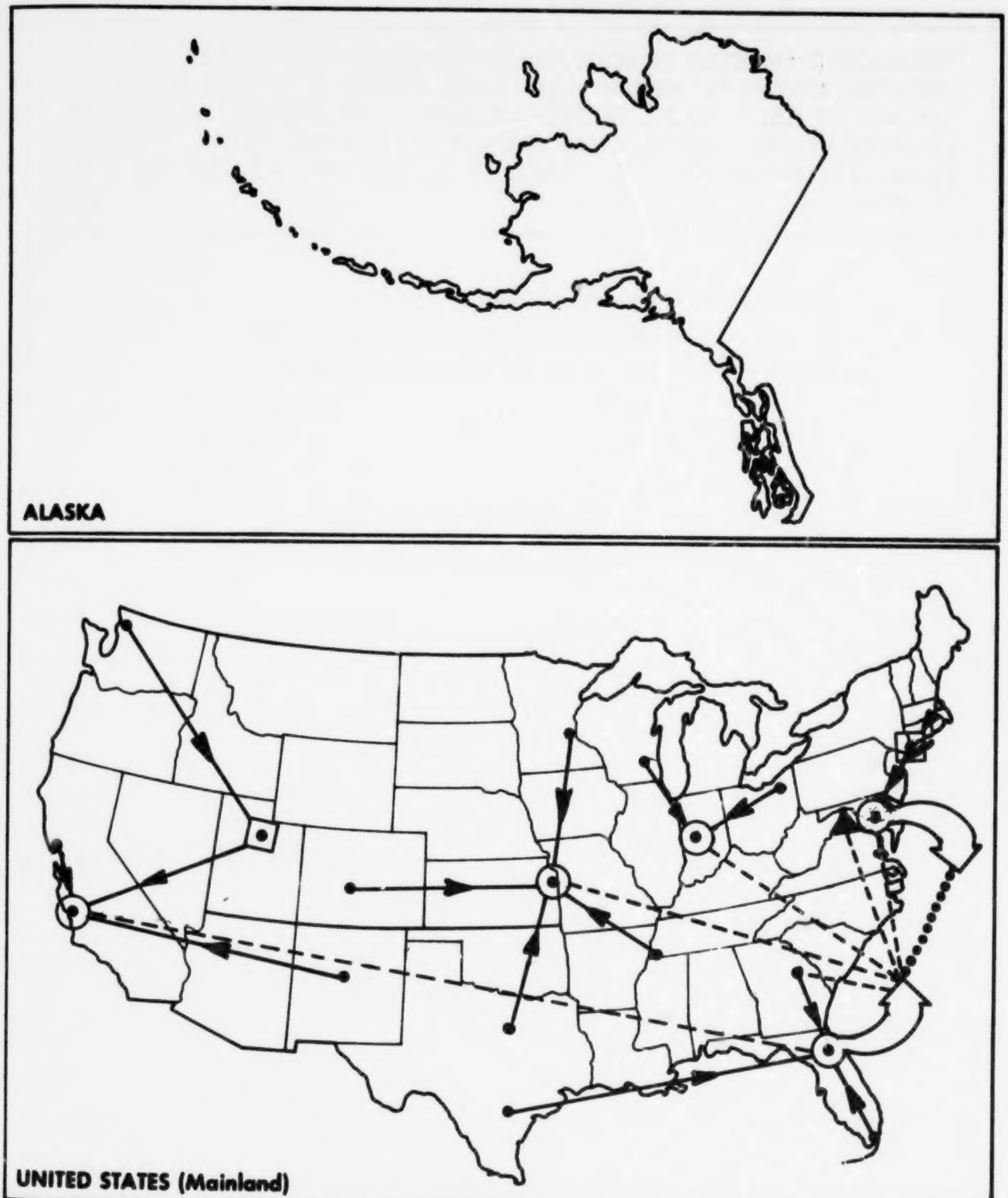
THESE SERVICES WILL BE PROVIDED BY NADIN 1A AND THE TELETYPE REPLACEMENT PROGRAM BY 1985.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1981 SYSTEM
SERVICE B TELETYPE NETWORK

THIS MAP DEPICTS THE CENTRAL FLOW CONTROL COMMUNICATIONS. CENTRAL FLOW CONTROL DATA CIRCUITS CONSIST OF 2,400 BPS LINES FROM FIVE STORE-AND-FORWARD ARTCCs TO THE JACKSONVILLE CENTRAL FLOW CONTROL COMPUTER.

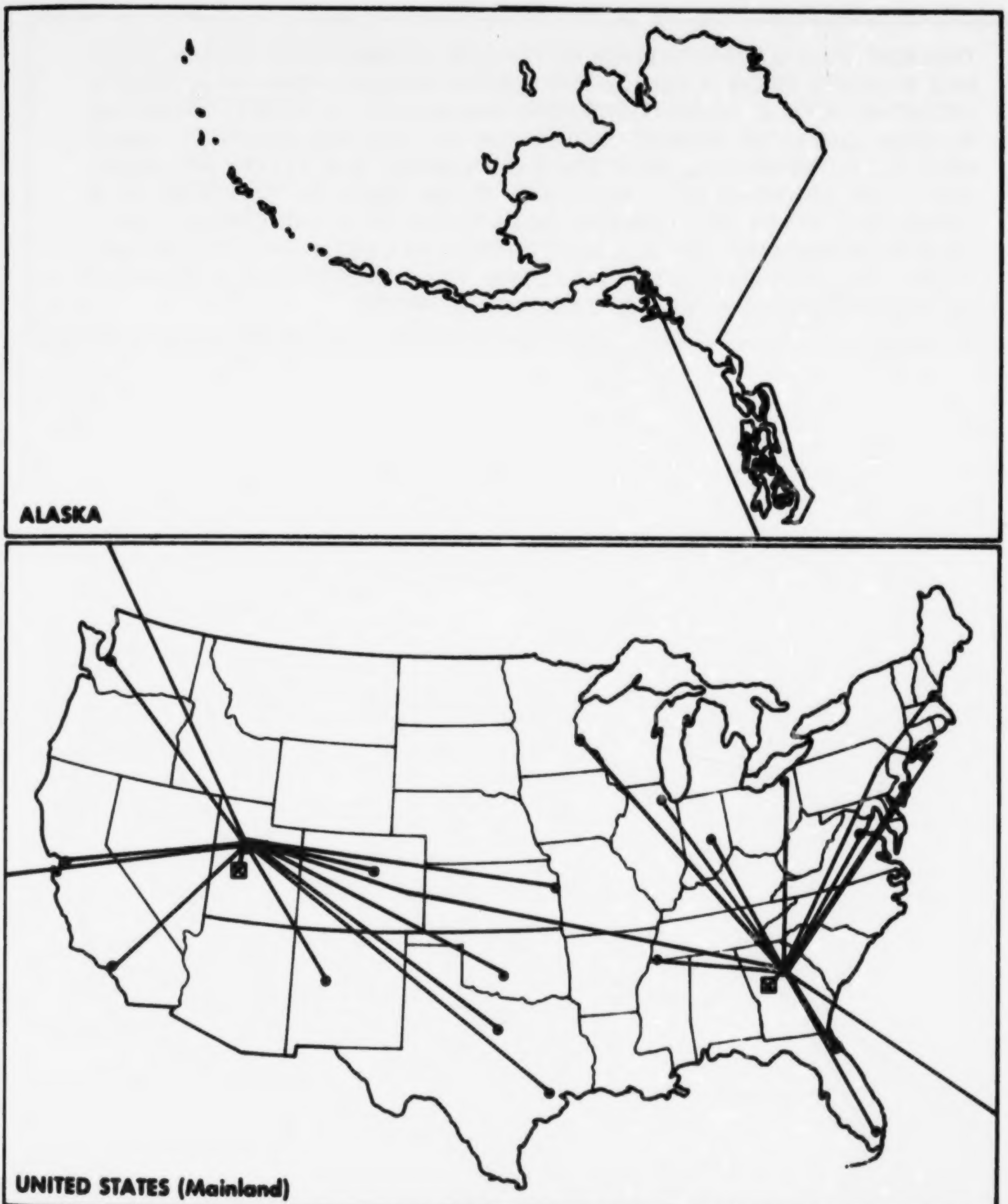
▲	**ATCCC EMERGENCY OPERATING FACILITY (MARTINSBURG & ATLANTA)**
●	**ARTCC (NODE)**
⊡	**ARTCC (RELAY CENTER)**
◎	**ARTCC (STORE-AND-FORWARD CENTER)**
◀	**EXISTING 2,400 BPS DATA CHANNELS**
---	**NEW DEDICATED 2,400 BPS DATA CHANNELS**
••••	**NEW MULTI-4800 BPS DATA CHANNELS**


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1981 SYSTEM
CURRENT CENTRAL FLOW CONTROL COMMUNICATIONS SYSTEM

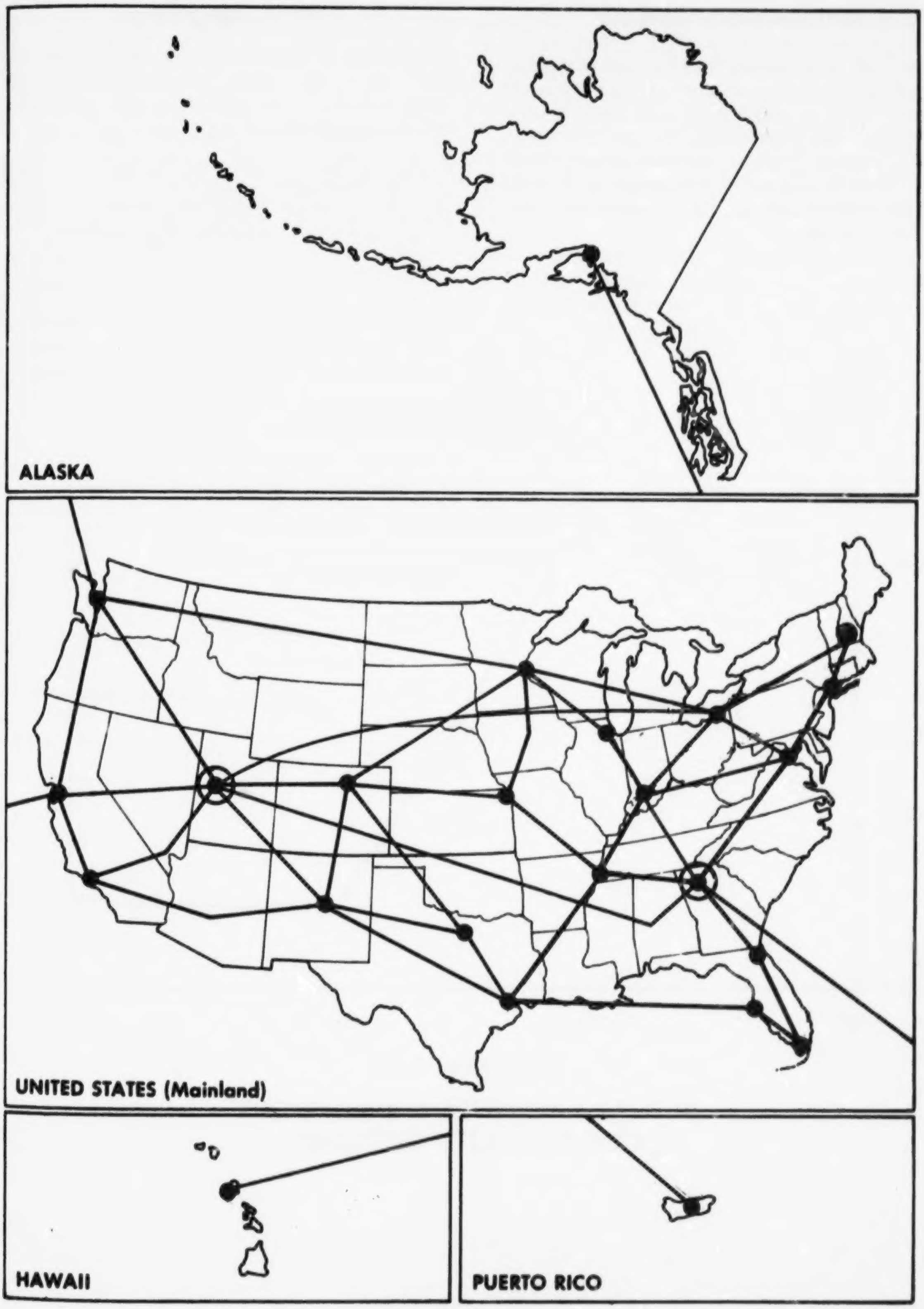
THE NADIN DUAL STAR CONFIGURATION REPLACES MULTIPLE LOW-SPEED SERVICES SHOWN IN THE 1981 TIME FRAME. MESSAGE SWITCHES WILL BE LOCAED AT SALT LAKE CITY AND ATLANTA. CONCENTRATORS WILL BE LOCATED IN EACH ARTCC. DUAL BACKUP IS PROVIDED, TOTAL CIRCUITS FROM CONCENTRATORS TO OTHER FACILITIES ARE NOT SHOWN FOR CLARITY.

☒ **LOCATION OF NADIN MESSAGE SWITCHES**


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1985 SYSTEM
NATIONAL DATA INTERCHANGE NETWORK (NADIN 1A)

THIS MAP SHOWS TYPICAL ENHANCED NADIN CONNECTIVITY WHERE NADIN HAS EVOLVED FROM A DUAL STAR CONFIGURATION (1985) TO A PACKET NETWORK WITH ALTERNATE ROUTING CAPABILITY. ALTERNATE ROUTING ALLOWS DATA TO BYPASS FAILED OR SATURATED CIRCUITS. NADIN PROTOCOL DESIGN WILL BE MEDIA INDEPENDENT AND ALLOW ANY COST-EFFECTIVE TRANSMISSION MEDIA MIX TO BE USED. BY THIS TIME, IT IS EXPECTED THAT NADIN, TOGETHER WITH ITS MULTIPLE TAIL CIRCUITS, WILL HAVE ABSORBED ALMOST ALL INDEPENDENT FAA DATA CIRCUITS. ACTUAL CONNECTIVITY IS SUBJECT TO ANALYSIS. TRANSMISSION FACILITIES WILL BE PROVIDED BY THE RML "BACKBONE" NETWORK.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1990 SYSTEM
NATIONAL DATA INTERCHANGE NETWORK (NADIN 2)

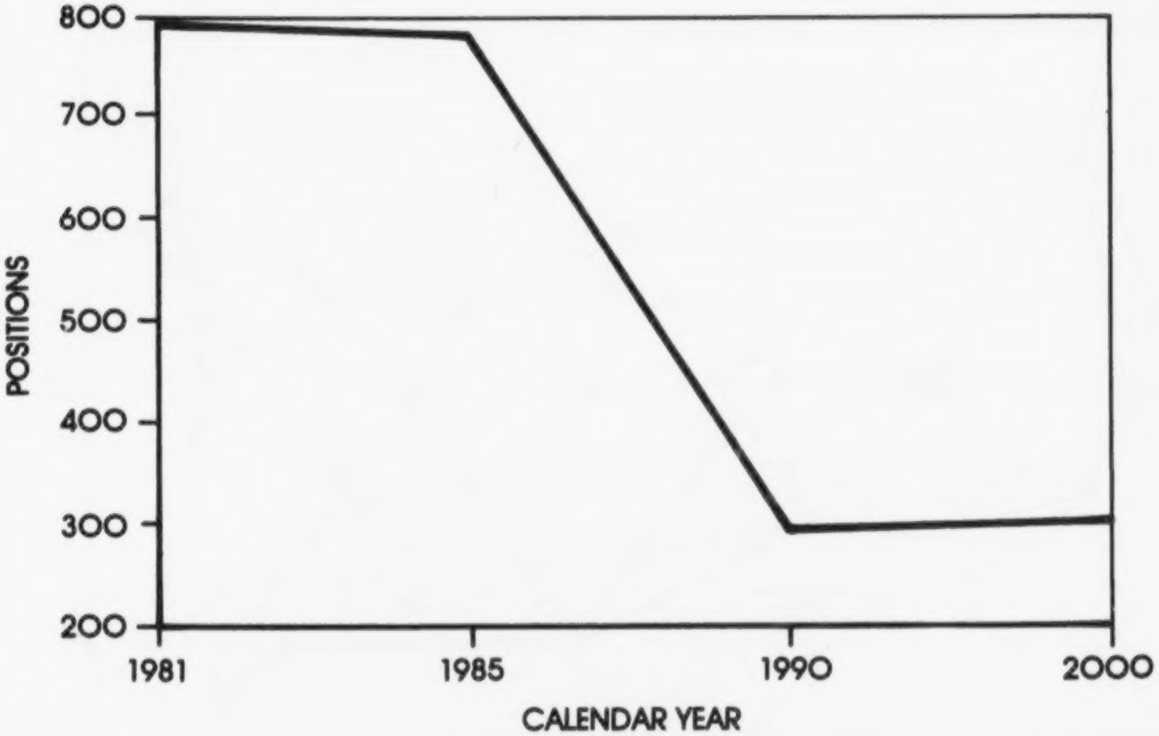
RETURN ON THE INVESTMENT

As a result of these planned actions, overall agency operating costs will be significantly reduced. The introduction of new technology will allow for a decrease in maintenance staffing despite the expansion of FAA-owned facilities to reduce reliance on leased systems. Leased services costs will be contained, and a more reliable and flexible data and voice transmission system will be available.

FIELD EMPLOYMENT

Employment levels reflect the Airway Facilities sector management and subordinate positions required to staff the interfacility system. Air Traffic staffing is not required for this system.

During the next 20 years, the interfacility system will undergo changes in hardware, software, and plant improvements. These changes will be reflected within Airway Facilities as shown in the chart below:



AIRWAY FACILITIES EMPLOYMENT (INTERFACILITY SYSTEMS)

The changes planned through the year 2000 will decrease current Airway Facilities personnel requirements for maintenance of interfacility systems at field facilities by 65 percent.

SUMMARY OF FACILITY CHANGES

During the period to 1985, high-speed data multiplexing will reduce the number of leased circuits needed to provide long-range radar data to en route centers. Improvements to the RML system will reduce maintenance tasks. The initial National Data Interchange Network (NADIN 1) will be implemented. Integrated communications switching systems (ICSS) will be installed at towers, TRACONs, and the initial automated flight service stations. The telecommunications management system will be upgraded.

By 1990 additional high-speed data multiplexing will be added, NADIN 2 will be implemented, vacuum-tube RML equipment will be replaced with solid-state, various RML systems will be interconnected to form a national network, and 46 additional television microwave links will be added to provide radar data to satellite towers. The teletypewriter replacement program will have replaced approximately 350 labor-intensive installations with modern leased terminal equipment.

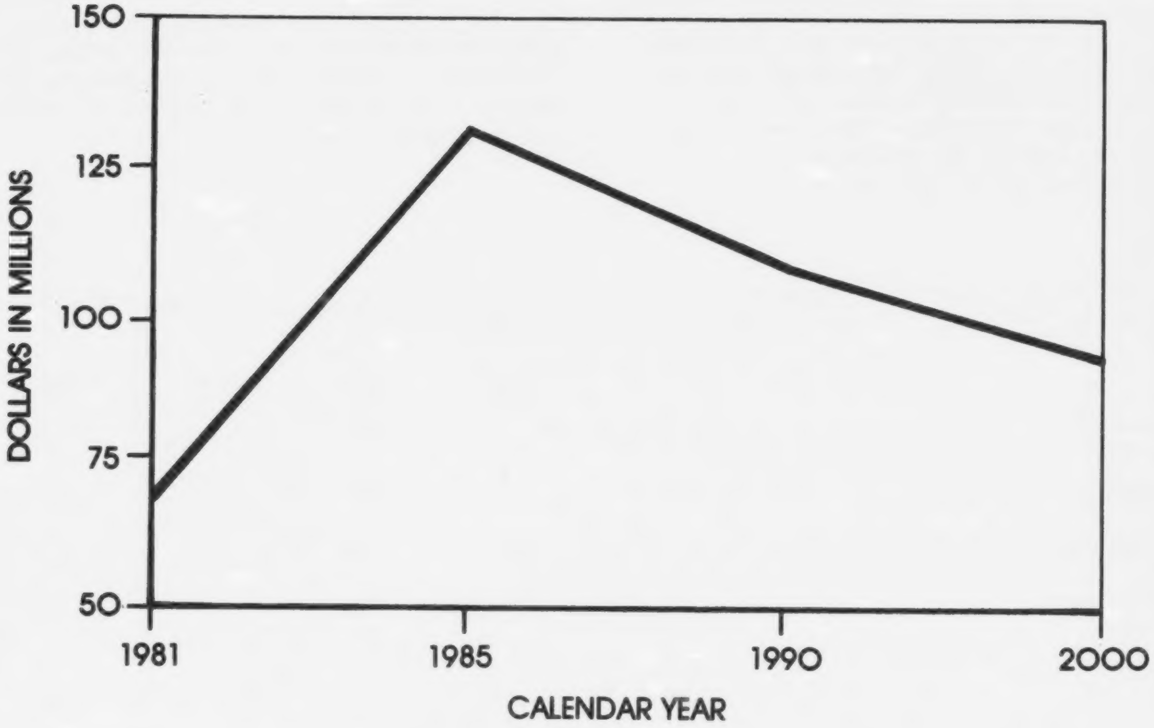
From 1990 to 2000, facility consolidation, continued expansion of NADIN functions, further use of RML, and replacement of leased voice switching systems with agency-owned equipment will continue to reduce overall operating costs.

INTERFACILITY COMMUNICATIONS SYSTEMS AIRWAY FACILITIES EMPLOYMENT CHANGES

	1981	1985	1990	2000
No. of Facilities	1,280	1,518	1,421	1,426
Airway Facilities Personnel	799	795	296	298
AF Productivity Quotient	1.60	1.90	4.80	4.79
Total AF Staffing	799	795	296	298

FIELD OPERATIONS COSTS

Operating costs for the interfacility system consist of estimated annual expenditures for personnel, rents and utilities, leased communications, and other miscellaneous categories. The costs for each year are a direct consequence of facility changes discussed in the previous section. Costs are in constant FY-81 dollars and are for field facilities.



OPERATIONS COSTS

For the interfacility system, all personnel costs have been attributed to Airway Facilities. These costs are derived by multiplying the total number of employee-years associated with the maintenance of field equipment by the average cost of an electronics technician in 1981: $34,100. A single-cost figure has been used here due to the current composition of the AF work force and the expectation that trainee technicians and administrative positions will remain small compared to the overall field work force. Rents and utility costs for this system have been increasing. The number of facilities is increasing.

Interfacility leased communications consist of all leased voice and data circuits between towers, TRACONs, FSSs, and ARTCCs/ACFs, plus leased teletypewriter replacement equipment.

Leased communications costs will change for the following reasons:

1981-1985—Costs increase as the result of new point-to-point communications requirements. Provision is also made for expected increases in the cost of these services as telecommunications deregulation proceeds.

1985-1990—Interfacility costs for leased circuits will begin dropping as leased switching systems are replaced by FAA-owned systems and as multiplexing starts having appreciable impact. These reductions are more than offset by increased equipment costs associated with the teletypewriter replacement program.

1990-2000—Costs will drop, in spite of major new requirements, largely as a result of the expanded use of the RML network for trunking and the increased use of satellites and competitive transmission sources.

INTERFACILITY COMMUNICATIONS SYSTEMS OPERATIONS COSTS (000)

	1981	1985	1990	2000
Airway Facilities Personnel	27,246	27,110	10,094	10,162
*Leased Communications	40,000	95,000	100,000	80,000
Rents & Utilities	1,567	3,679	1,371	1,381
Other	2,997	5,134	1,913	1,927
Totals	71,810	130,923	113,378	93,470

*Costs shown are best estimates at the time of publication. Actual costs may differ due to negotiated tariffs.

ENERGY COSTS

1981-1985—Energy consumption increases due to expansion in systems and equipment.

1985-2000—Energy consumption decreases due to RML replacement with energy-efficient equipment and reductions in heating/cooling costs.

INTERFACILITY COMMUNICATIONS SYSTEMS ENERGY DATA

	1981	1985	1990	2000
Energy (kWh × 10^6)	15.00	16.00	13.00	12.00
Costs (Millions)	0.75	0.80	0.65	0.60

SPECIFIC PROJECTS

The plan calls for nine separate projects to improve interfacility communications.

PROJECTS	IMPLEMENTATION	
	FIRST	LAST
TRANSMISSION		
1. RML Trunking	1982	1985
2. Data Multiplexing	1983	1991
3. RML Replacement and Expansion	1985	1989
4. Television Microwave Link (TML)	1986	1987
5. Airport Telecommunications	1985	1995
SWITCHING		
6. National Data Interchange Network (NADIN) 1A	1985	1985
7. National Data INterchange Network (NADIN) 2	1985	1989
RADIO CONTROL		
8. Radio Control Equipment (RCE)	1987	1990
TERMINAL DEVICES		
9. Teletypewriter Replacement	1981	1986

PROJECT SUMMARY

PROJECT 1: RML Trunking

Purpose: The FAA operates an extensive network of RMLs terminating at ARTCCs which are currently used primarily for radar remoting and backup emergency communications. These links have additional unused signal-carrying capability. Since over 40 percent of FAA leased circuit costs come from circuits terminating at ARTCCs, many circuits can be routed through these links, thereby, reducing leased-circuit costs.

From the work already completed, the anticipated savings at current tariff rates is over $2 million per year. Additional reduction in leased-line requirements is possible by rerouting more circuits from remote communications and navigation facilities over selected FAA-owned RMLs. A further savings of $4-5 million per year is expected when the project is completed. Analysis indicates that this investment will be amortized in less than 2 years.

Approach: FAA regions are submitting projects to Washington headquarters aimed at reducing leased-line cost via RML trunking. Based upon the cost effectiveness of these submittals, money has been and will be distributed to the regions. Funds were distributed in FY-82 and FY-83 for these projects. Additional monies will be provided during FY-84. Trunking for FY-85 and beyond will be accomplished as part of the RML replacement/expansion project and will not require separate funding.

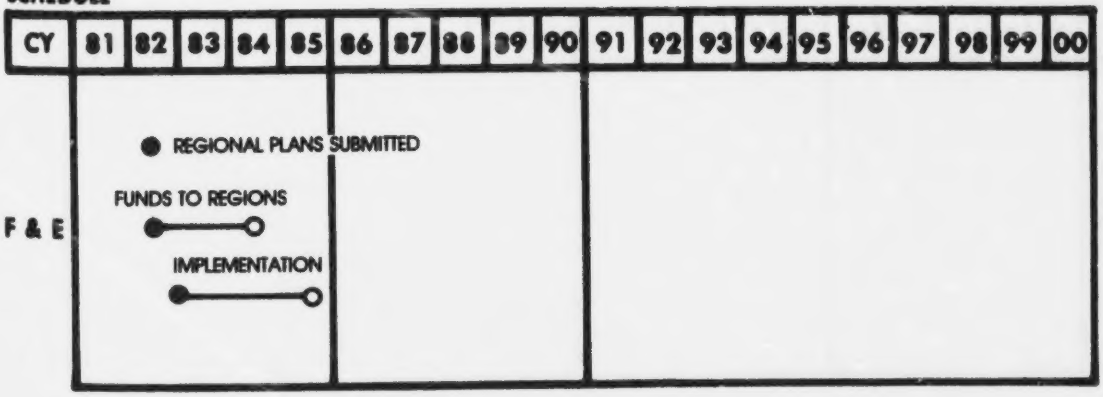
Products: The regions will install multiplexing equipment at existing RML sites and eliminate leased lines in accordance with regional plans.

Related Projects/Activities: Data multiplexing and RML replacement and expansion.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

SCHEDULE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F & E
REGIONAL PLANS SUBMITTED
FUNDS TO REGIONS
IMPLEMENTATION

PROJECT 2: Data Multiplexing

Purpose: Lower leased communications and maintenance costs result from using data multiplexing equipment. This equipment consolidates information, currently requiring multiple lines, and transmits it over fewer lines. The use of data multiplexing is an integral part of FAA's strategy for cost-effective interfacility communications transmission.

Approach: Where information is being transmitted over multiple low-speed lines, multiplexing modems will combine the data and transmit it over a single line, thus, replacing the low-speed circuits. Applications envisioned include: radar site to ARTCC data, ARTCC to ARTCC data, and FSDPS (at ARTCCs) to AFSS data. Readily available off-the-shelf multiplexing equipment will be used. It promises amortization of multiplexing costs in less than 2 years. A monitoring and analysis capability is incorporated as part of the modem equipment. Modem monitoring and end-to-end monitoring of the transmission media will be reported to a monitoring and control console at each ARTCC. This monitoring capability will improve the reliability of data flow and reduce maintenance costs by pinpointing failure locations as they occur.

This project is being accomplished in three phases: (1) en route and central flow control, (2) terminal, and (3) FSS. The major hardware building block is the 14.4 k bps multiplexing modem. Monitoring systems will be installed at each ARTCC.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

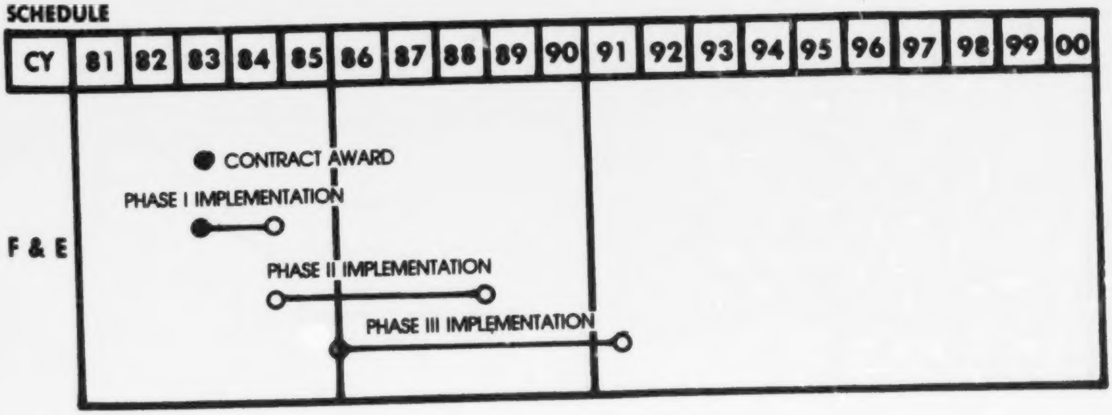
Commercially available equipment is being initially leased using a requirements type contract. An option to buy is included in the contract.

Products:

- Phase I will provide multiplexing modems to be distributed to 20 ARTCCs and 150 radar sites.
- Phase II will provide additional units for terminal facilities.
- Phase III will provide modems for FSS to FSDPS data.

Related Projects/Activities: RML Trunking, RML Replacement and Expansion, RRWDS, ARTS, FDIO, AWOS, Traffic Management System, AFSS, NADIN, RMMS.

SCHEDULE



PROJECT 3: RML Replacement and Expansion

Purpose: The FAA RML system consists of outdated equipment which is expensive to maintain. This system is required to transmit broadband radar data until late in the 1980's. It must be replaced.

To maximize the cost effectiveness and availability of the interfacility voice and data transmission needed in the future, an integrated transmission system must be implemented. This system must consider the total traffic, both national and area.

This project contributes to the above objectives by providing a modern national microwave transmission network (for broadband radar, voice, and data) with capacity for future requirements and alternate routing capability. The network will eventually tie all ACFs together. The RML, along with satellites, will be used for national communications requirements as well as area network trunking.

This project will ensure the reliable transmission of radar data, reduce the cost for interfacility communications, and improve system availability while providing the flexibility to accommodate the interfacility communications requirements of the NAS Plan.

Approach: An analysis was completed to develop a network design by examining user requirements and FAA objectives with respect to the performance-cost aspects. Transmission alternatives were analyzed, including satellites and leased circuits. Based on this analysis, plans for an overall comprehensive backbone network have been developed which use the existing RML as a basis, supplemented by leased circuits, satellites, and other FAA links where cost-effective.

The existing RML system will serve as a general transmission medium for FAA voice and data communications. It is highly cost-effective to convert existing "special-purpose" links used for radar remoting to "general-purpose" links used for interfacility communications. The existing links will be upgraded, and additional links will be established to complete a nationwide network.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

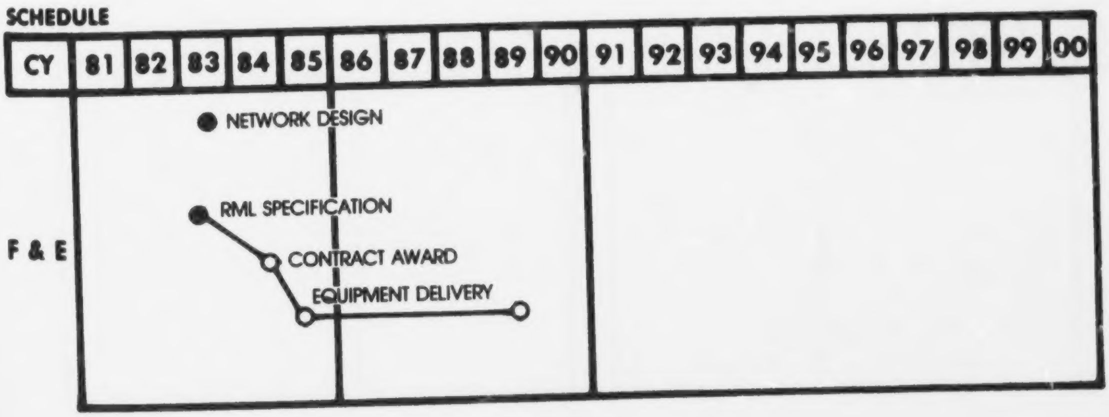
In addition to the RML network equipment, a network control system for dual-level switching of channels and trunk alternate routing will be procured. A diagnostic and monitoring system will be part of the RML equipment.

Monitoring of the network path integrity will be done with the diagnostic and monitoring equipment obtained as part of the RML network. Monitoring and diagnostics for the channel equipment portion of the RML network will be done with separate data and voice channel monitoring equipment. The data channel monitoring equipment has been procured as part of the data multiplexing program.

Products:

- RML network plan.
- Specifications for RML.
- Replacement of present 750 RMLs.
- Establishment of additional 250 RML facilities.

Related Projects/Activities: Facility consolidation, network coverage analysis, area control facility establishment. All NAS Plan programs requiring interfacility communications, NADIN, and NAS spectrum engineering.



PROJECT 4: Television Microwave Link (TML)

Purpose: This project will provide television microwave link systems to transmit BRITE radar display information to satellite airport traffic control towers (ATCT).

Approach: Procure commercially available equipment to relay the display of radar data. This includes sending and receiving equipment and any intermediate repeater stations.

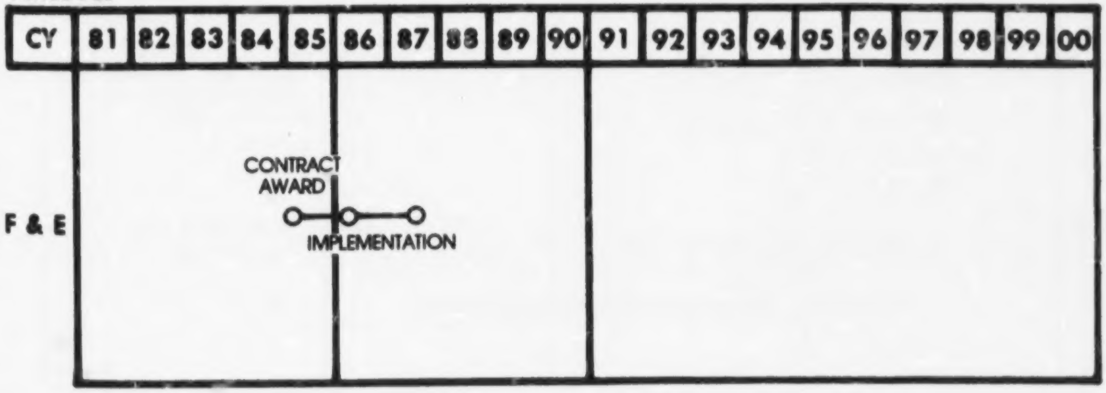
Products: 46 locations.

Related Projects/Activities: The BRITE project (in chapter III, Terminal) provides the remote radar displays. These TML links may be used to extend the interfacility transmission system established by the RML Replacement and Expansion project.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

SCHEDULE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F & E
CONTRACT AWARD
IMPLEMENTATION

PROJECT 5: Airport Telecommunications

Purpose: Control, signal, and communication cables at many airports are reaching the point where replacement is necessary for reliable or expanded operation. This program provides for the replacement of deteriorating cables at airports either "in-kind" or with systems employing new technology, such as fiber optics and packet radio. Replacement of the cables at 100 high- and intermediate-activity airports with fiber optics will:

- Reduce installation costs when fiber optics cable is installed concurrent with power cable loop systems.
- Allow cable repair with minimum outages.
- Eliminate cable damage from lightning surges.
- Reduce interference from noise intrusion.

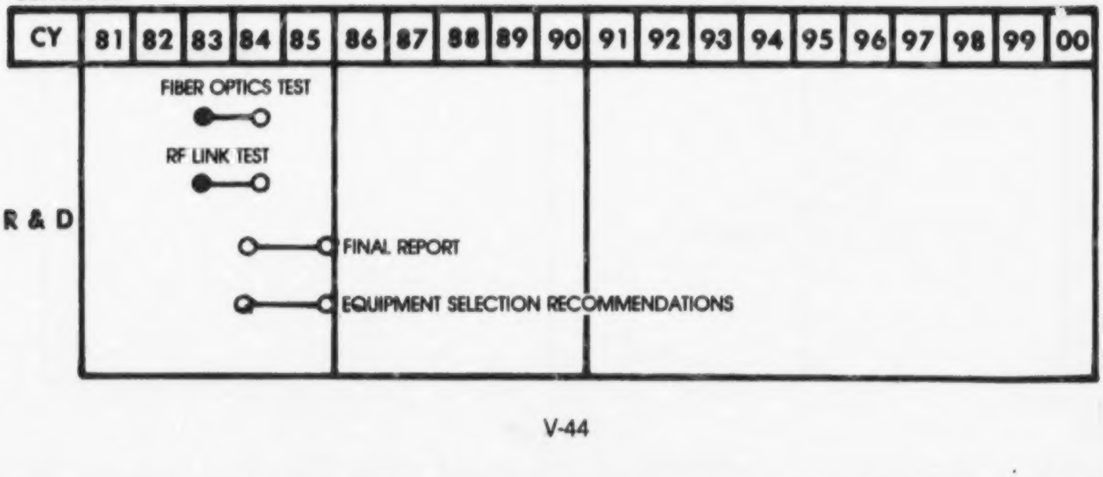
Replacement of the cables at 300 low-activity airports with packet radio will provide cost-effective, state-of-the-art support for remote maintenance monitoring.

Approach: Each region will develop a master plan for control, signal, and communications cable replacement installations at each of the high-, intermediate-, and low-activity airports. Regional planning for high- and intermediate-activity airports will consider the cost advantages of simultaneous installation of telecommunications cables and power cable loops. Planning for cable replacement at the low-activity airports will address the application of packet radio or fiber optics. Cost/performance analyses will determine the utilization of fiber optics, packet radio, or other methods.

This program will provide telecommunications installations which will allow for future capacity and expansion. Installation in the same trench with the power cable loop system will provide compatibility with remote maintenance monitoring and redundancy for operational functions.

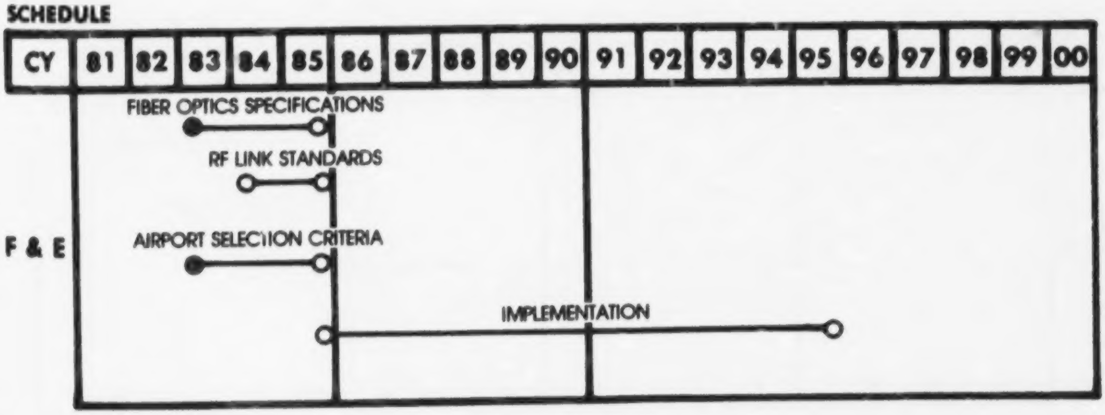
Outage time resulting from cable damage will be minimized. Where feasible, fiber optics cable and associated equipment will be installed.

SCHEDULE



Products: Replacement of telecommunications cable systems at 100 high- and intermediate-activity airports and 300 low-activity airports.

Related Projects/Activities: Microwave landing systems, facility consolidation, remote maintenance monitoring, telecommunications on airports, airport power cable loop systems, and NAS spectrum engineering.


SCHEDULE

PROJECT 6: National Data Interchange Network (NADIN) 1A

Purpose: The NADIN is a national digital message switching network for aeronautical data that will initially replace a number of inefficient, independent, low-speed networks currently in operation and can be expanded to meet the future data switching requirements of most programs in this Plan. The initial NADIN system, or NADIN 1, integrates the AFTN, Service B, national airspace system network (NASNET) and interim flow control and provides service to several FAA external users; i.e., airlines, ARINC, USAF, etc. In doing this, Service B data transmissions will be replaced by medium-speed data transmissions for use at Model 1 AFSS locations. NADIN 1A provides switching service to the aviation weather processor (AWP) and the flight service data processing system (FSDPS) for Model 2 AFSS locations.

The cost of communications services is steadily increasing. The replacement of the existing FAA communications services and consolidation into NADIN results in savings in maintenance costs, economically provides for improved services and system expansion, improves reliability, reduces leased-line requirements, and consolidates FAA communications within the agency to provide the necessary system interoperability.

Approach: Establish an operational data switching system capable of satisfying the current and near term requirements for data switching in the NAS. The system will replace the existing outdated equipment with modern, solid-state equipment which requires less maintenance. The NADIN system will have modular expandability to meet data communications requirements for future systems. It will improve operational effectiveness; reduce operational cost through consolidation of independent, low-speed services; and provide better utilization feedback and system management capabilities.

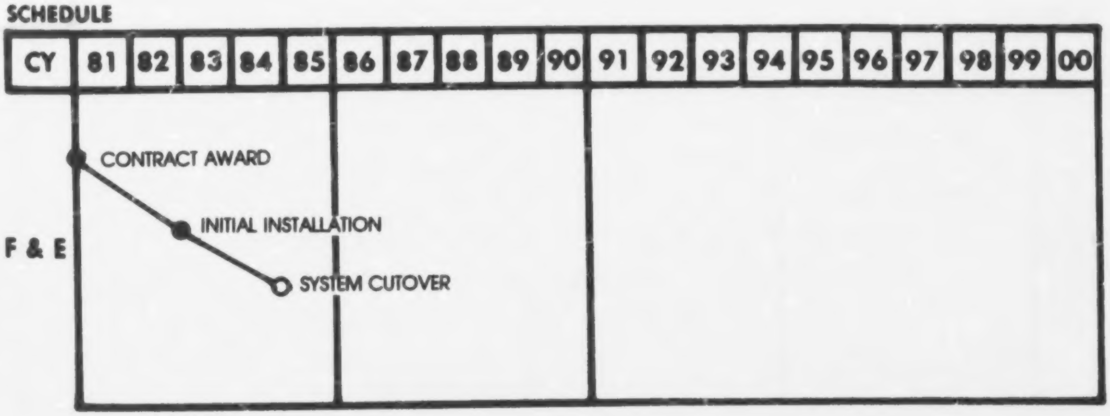
SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

Products:

- 2 operational switching centers (Atlanta and Salt Lake City).
- 23 operational data concentrators at ARTCCs.
- Support switch and concentrator at the FAA Technical Center.
- 2 training concentrators at the FAA Academy.

Related Projects/Activities: NADIN 1A provides support for current and near-term new FAA systems that require data communications. Near-term future systems include FSAS Model 2. NADIN 2 will be an expansion to NADIN 1A to meet requirements through the 1990's. NADIN will interface with the Department of Defense AUTODIN system. NADIN will provide the switching for the teletypewriter replacement equipment.



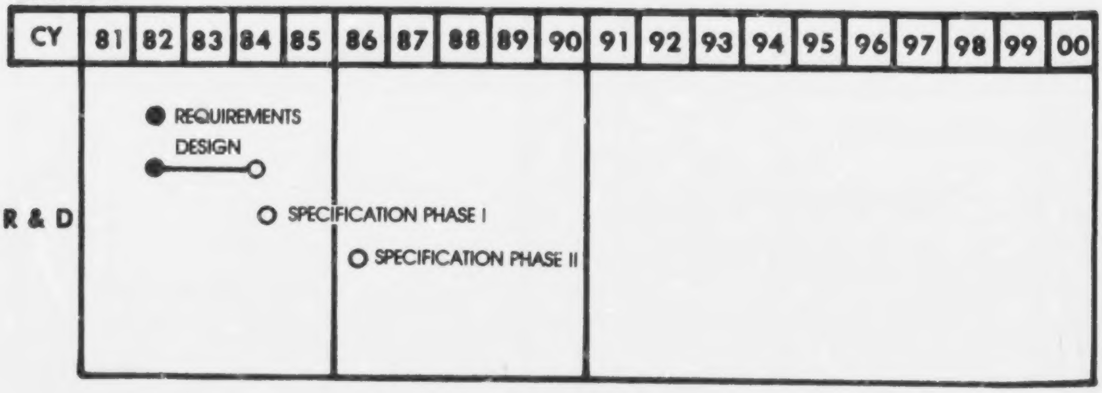
PROJECT 7: National Data Interchange Network (NADIN) 2

Purpose: In addition to those data switching requirements that will be served by NADIN 1A, it is necessary to expand the system to meet the data switching requirements of other major FAA systems and functions in this plan (e.g., center computer-to-center computer, center computer-to-terminal computer, remote maintenance monitoring system (RMMS), advanced weather systems, advanced automation system, the facility (center and terminal) consolidation program, and Mode S/data link).

This project will provide the expanded data switching capability and network monitoring functions required to meet the future FAA communications needs for data switching. Increased capacity, flexibility, and service availability will be achieved through the use of packet switching and a highly connected system architecture to replace the dual-star of NADIN 1A. Introducing packet nodes into the network will provide significant cost savings and performance upgrading.

Approach: The system design will be based upon the data flow requirements of new systems and consolidation as the NAS evolves. The NADIN IA support system at the FAA Technical Center will be used to integrate and test the new hardware and software of NADIN 2. A highly connected network using packet data and packet switch nodes with virtual circuit and alternate routing capability will be implemented. The project must be coordinated with other FAA communications initiatives to provide the required transmission between network packet nodes. A centralized network control and monitoring facility also will be established. Standardization of access interface and exchange protocols will be maintained to ensure future flexibility for system evolution. Message switching will continue to be provided by this network as well as quick-response, interactive data transfer and efficient file (data base) transfer.

SCHEDULE



NADIN 2 will be a competitively acquired expansion of NADIN IA. Two phases will be involved. Phase I will implement packet switching, packet nodes, and added transmission trunking between nodes. Phase II will add capacity, connectivity, and interfaces to the system.

Products:

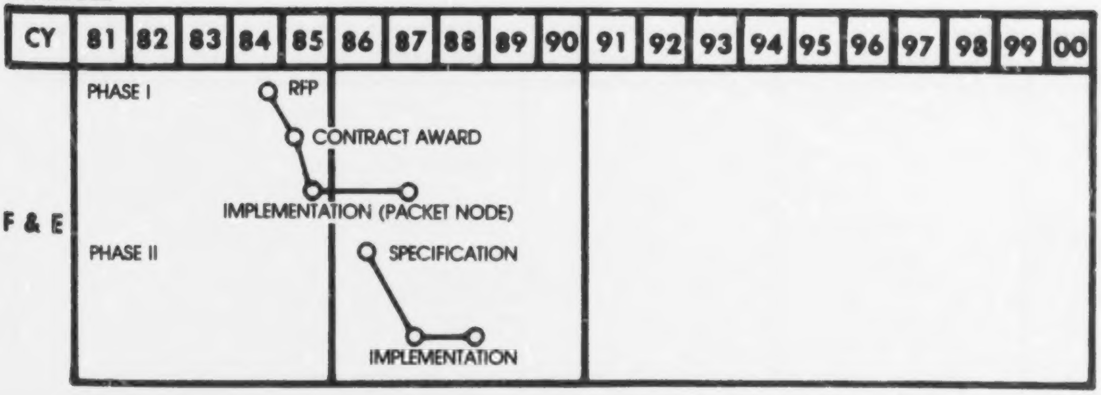
- Approximately 22 packet switch nodes will be added to the initial NADIN 1A system at 20 CONUS ARTCCs and two NADIN message switching centers.

- Two support systems will be provided to the Technical Center.

- Two support systems will be provided to the Academy for training.

Related Projects/Activities: NADIN will interface with virtually all NAS operational systems requiring interfacility data switching service. Future needs for area control facilities/advanced automation system will be met by this NADIN expansion. NADIN will be used to switch maintenance management system communications and will accommodate some DOT administrative data requirements.

SCHEDULE



PROJECT 8: Radio Control Equipment (RCE)

Purpose: This project will replace the present radio signaling and tone control equipment to improve operational performance and reduce maintenance cost. The replacement of obsolete radio control equipment will eliminate operational deficiencies and improve air-ground service. This equipment will be used for control and remote maintenance monitoring of RCAG, RTR, RCO, and RCF facilities. Additionally, it will standardize the interface with VSCS, Tower Communications System, and ICSS. This equipment will include the line-combining function (multiplexing) required for FSS modernization and the facility consolidations.

Approach: The approach is to replace existing radio tone control equipment with modern equipment which uses presently available technology, performs current functions and services, and adds an RMM capability. The contract will provide for remote maintenance monitoring capability where RCAG RMMS has not been installed or has insufficient capacity for all channels.

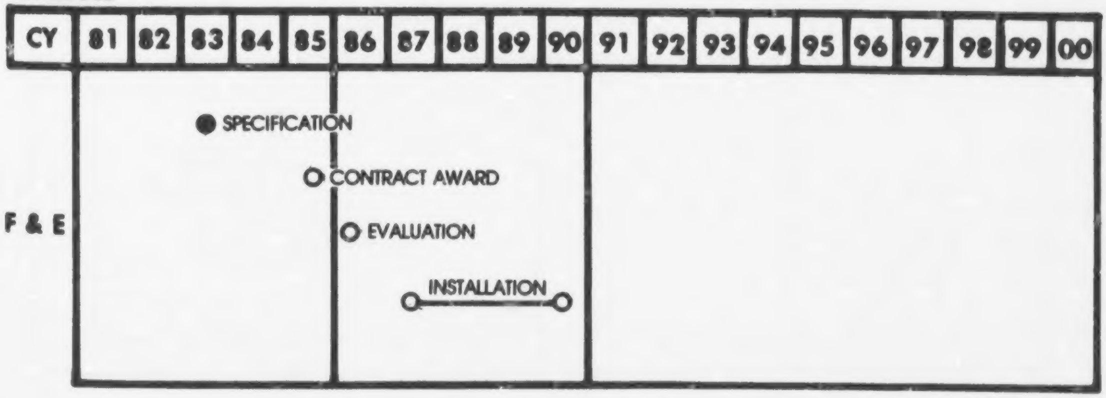
Products: Replacement of 4,094 channels of tone equipment starting in FY-87.

Related Projects/Activities: RMM, VSCS, ICSS, TCS, and communications facility consolidations.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

SCHEDULE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F & E
SPECIFICATION
CONTRACT AWARD
EVALUATION
INSTALLATION

PROJECT 9: Teletypewriter Replacement

Purpose: To expedite and ensure the transmission of weather and flight plan information to pilots and agency personnel, this project provides a replacement for the low-speed teletypewriter equipment at FAA field facilities and the most active military base operations.

Approach: The state of Alaska has eliminated all Model 28 teletypewriter equipment by leasing a system to serve all FAA facilities, NWS offices, military, and nongovernment users. The following facilities are still equipped with Model 28 teletypewriter equipment for service as indicated.

Facility	Type Service
144 CONUS FSSs	Service B
139 CONUS FSSs	Service A, B, Request/Reply
3 Offshore FSSs	Service B
20 CONUS ARTCCs	Service A, B
1 Offshore ARTCC	Service B
2 Offshore CERAPs	Service B
107 Military base operations	Service B
8 Regional offices excluding Alaskan Region	Service B
25 FAA Academy (operations training)	Service A, B
3 Emergency operations facilities (EOF)	Service A, B
20 Miscellaneous (FAA Technical Center/Depot)	Service A, B
1 FIDO Atlanta	Service A, B
1 General Aviation District Office	Service A, B

SCHEDULE

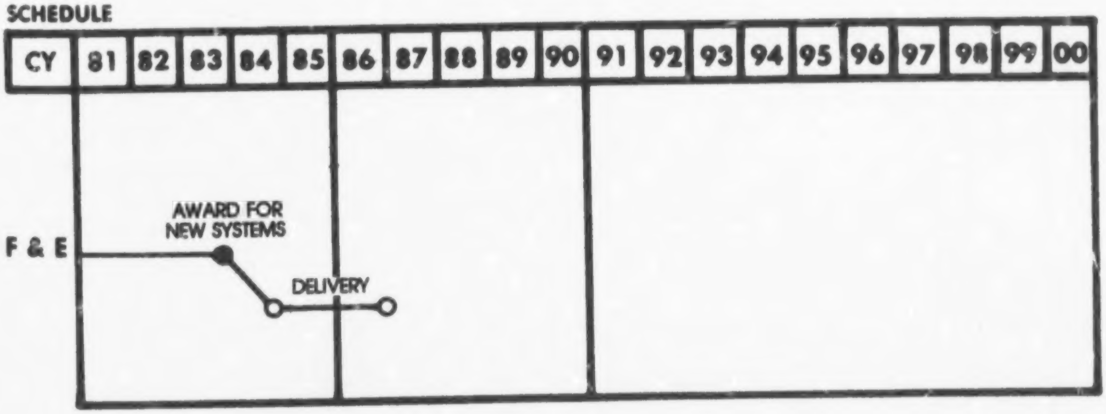
CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

A previous program (leased Service A) replaced the Model 28 low-speed teletypewriter equipment at 144 of these facilities. The leased Service A system program will be expanded during 1984 to replace the equipment used for Service A at an additional 139 FSSs. For Service B, similar replacement equipment will be provided to 156 military base operations (including the existing 107), 283 CONUS FSSs, and the 20 ARTCCs. The remaining facilities with Model 28 equipment will receive leased systems from 1984 to 1986.

Products: Leased equipment as indicated above.

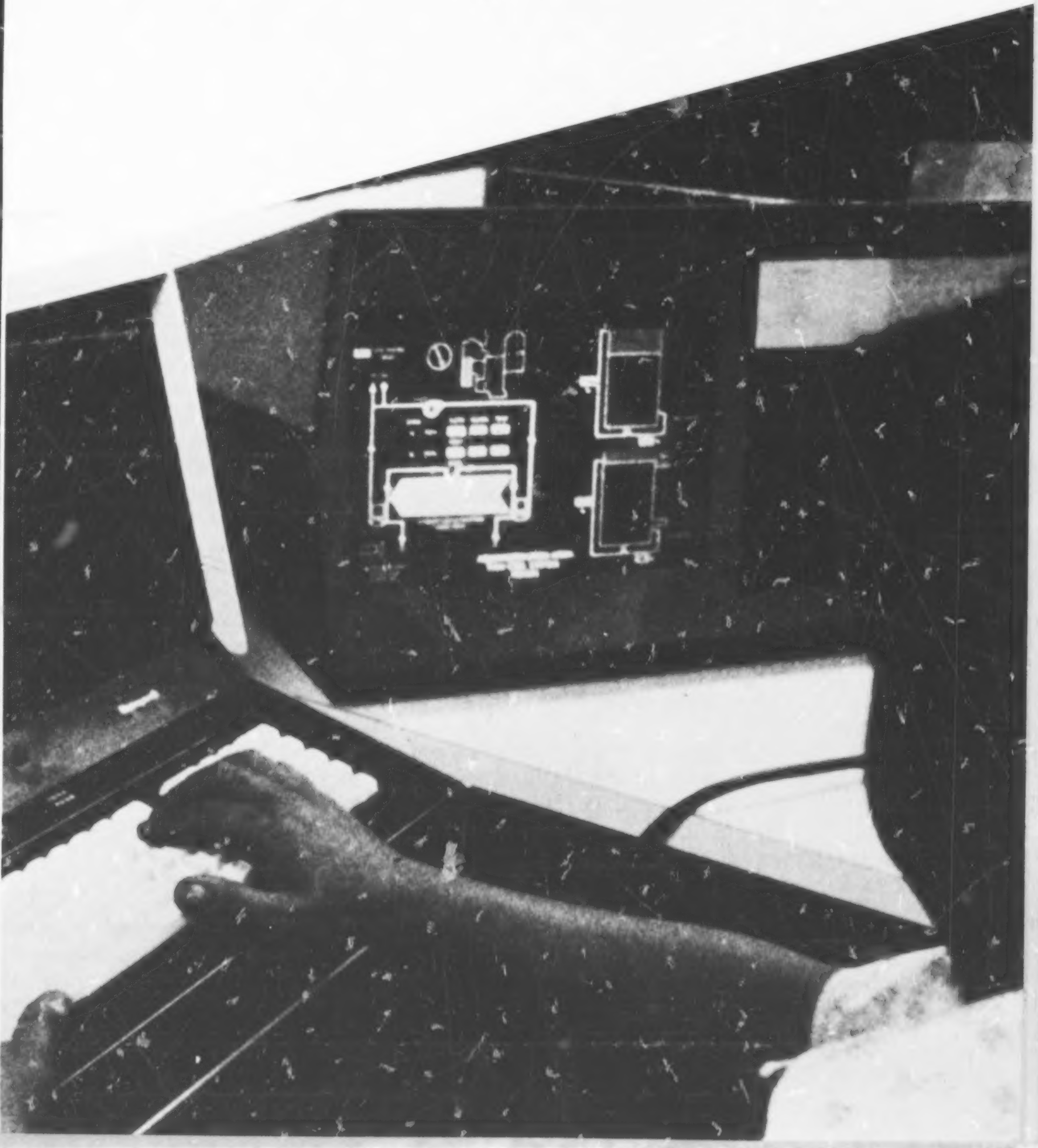
Related Projects/Activities: Service B expansion is predicated on the availability of NADIN 1A in late 1984. As FSSs are consolidated, the number of leased systems will decrease.

SCHEDULE



CHAPTER VI

MAINTENANCE AND OPERATIONS SUPPORT SYSTEMS



MAINTENANCE AND OPERATIONS SUPPORT SYSTEMS

Maintenance and operations support systems are necessary for the operation of the National Airspace System. They include buildings; plants; access roads; special purpose vehicles; laboratory facilities at the FAA Technical Center; systems, sources, or processes required for support of maintenance operations; flight inspections; emergency programs; and the facility and equipment (F&E) process itself.

Maintenance and operations support systems are the elements required across the board to generally support the National Airspace System.

The projects in this chapter focus on flight inspections, maintenance support, emergency systems, power and structure improvements, laboratories, and support facilities.

The flight inspection program certifies the operation of FAA facilities that transmit the precision signals needed for navigation and surveillance. Currently, about 27,000 hours of flight inspection operations are performed annually out of seven flight inspection field offices. These operations include initial certification of new facilities, periodic inspections of facilities under FAA regulations, and certification of facility performance following accidents.

Maintenance support is accomplished by a staff of electronic and environmental technicians from approximately 1,000 work centers associated with 115 sector offices. This support usually consists of periodic preventive maintenance. It requires frequent site visits and, in some cases, the staffing of facilities to assure immediate response in the event of a required maintenance action.

Training for most of the technical work force is at the FAA Academy in Oklahoma City. Training capabilities include resident training along with some computer-based instruction and some correspondence courses. Execution of the FAA National Airspace System Plan will result in a modernized and cost-effective air traffic control system. Life-cycle support of new and existing systems must be equally cost-effective. Advanced technology and concepts must also be explored for future integration into the NAS. Laboratories are required to provide support for the present field operational systems and the exploration of advanced concepts.

Laboratory facilities and systems are provided for these efforts. These facilities are used for development of hardware and software changes to the operational systems, technical support of field personnel, and operational testing and evaluation of new systems.

National field engineering support is provided by a cadre of technical experts. Support for operational automated systems is accomplished by a team assigned to the FAA Technical Center. Support for non-automated systems is provided by a team headquartered at the Mike Monroney Aeronautical Center. Logistics support is provided by the FAA Depot located at the Aeronautical Center.

The emergency systems are presently a network of high-frequency, single-sideband communications. The network provides management the capability for continuing or restoring operations in cases of severe weather, national disasters, and other losses of normal communications channels. It is also a means of nonsecure backup communications for defense readiness situations. The maintenance communication network (FM broadcast) now provides limited capability for routine communications with the remotely located maintenance personnel acting as a backup for emergency requirements.

Support facilities are consistent with the general technology of FAA systems. Most FAA systems and equipment use vacuum-tube technology requiring frequent maintenance. In many cases, the electric power supporting this equipment necessitates engine generator standby systems.

Air conditioning, heating, and buildings are set up to provide an environment for the equipment, as well as for the maintenance staff. In some remote areas, particularly in Alaska, the FAA provides employee living quarters and other public services.

The NAS is greatly dependent upon the use of the radio frequency spectrum. Effective management of the spectrum is extremely vital to the support of the NAS.

THE NEW APPROACH

There is ample room for cost reduction in the areas of maintenance, flight inspection, training, logistics, FAA-owned housing, and energy.

The agency is in the early stages of a major program to reduce maintenance support. This program, called the Maintenance Program for the 1980's, is centered around the replacement of vacuum-tube technology systems with solid-state equipment, the introduction of remote maintenance monitoring of facilities, and the establishment of an improved maintenance management system.

By using the more reliable, readily available, solid-state systems, the FAA will be able to improve maintenance productivity and decrease cost.

Instead of periodic preventive maintenance and frequent onsite visits, the FAA will be able to continually monitor system performance from maintenance control centers. This will reduce travel requirements and, therefore, costs. Also, by using remote monitoring techniques, the FAA can eliminate personnel at many facilities and consolidate maintenance personnel into a relatively small number of centralized work centers without harm to service.

Onsite corrective maintenance at remote locations will be limited to the replacement of lowest replaceable units (LRU). This will minimize service restoration time and minimize the requirement for costly test equipment at these locations. Repair of the LRUs will be performed at central repair facilities (CRF) which will be equipped with the necessary diagnostic and test equipment and staffed by skilled personnel.

The Maintenance Program for the 1980's also includes modernization of some buildings and plant facilities. This will provide the agency with an opportunity to institute energy-saving designs and practices.

Work force consolidation depends partly on the replacement of engine generators and removal of other systems that require onsite personnel. Facility consolidation and remote monitoring will allow sharp reductions in FAA-owned housing at facilities in isolated areas. A similar evolution has been planned for flight inspection. New techniques, more fuel-efficient aircraft, policy review and updating, new system capabilities for automatic flight inspection, consolidation of work force, and the coupling of flight inspection requirements with schedules consistent with remote monitoring feedback will be implemented. These actions are expected to significantly reduce operating costs.

New laboratories at the FAA Technical Center will be established, upgraded, and used for the testing and evaluation of new systems prior to acceptance and field implementation. The two major laboratories being established to support F&E are the systems support laboratory (SSL) and the general support laboratory (GSL).

The system support laboratory will be used for direct field assistance to technicians; development and testing of hardware, software, and firmware modifications; and support of new development activities.

The general support laboratory will support the SSL and will consist of general purpose systems, facilities, and aircraft.

HOW THE SYSTEM WILL EVOLVE

The Maintenance Program for the 1980's will be accomplished over the next 8 to 10 years. Replacement of VORs, VORTACs, and remote communications air and ground facilities already has begun, along with implementation of a central processor at ARTCCs to permit monitoring of remote en route facilities from a central location. As new or replacement systems are implemented, they will be incorporated into the remote monitoring network. Adherence to agency standards will assure that each new system is consistent with the maintenance policies.

By 1985, the number of Airway Facilities sectors will be reduced from 115 to 86. Computer-based instruction (CBI) will be instituted for many of the systems. Engine generators serving as standby power sources will be replaced by battery backup systems at many locations.

Establish new laboratories, and upgrade others, for field support and NAS modernization at the FAA Technical Center. These laboratories will change continuously as new systems requiring test and evaluation enter the inventory.

By 1990, the number of sectors will be reduced to 80. Each sector will have a central processor that monitors most of the FAA remote equipment in that sector. The sectors will become self-contained units providing repair of some modules and failed parts; accomplishing onsite training for large portions of basic system principles; and deploying technicians to remote facilities, as required, for maintenance.

Equipment training will still be provided at the FAA Academy, which will also be responsible for development of field training courses.

Repair of large or difficult-to-repair items will continue to be accomplished at the FAA Depot.

The Maintenance Program for the 1980's will be fully implemented by 1992, and the number of sectors will be reduced to 65 by the year 2000.

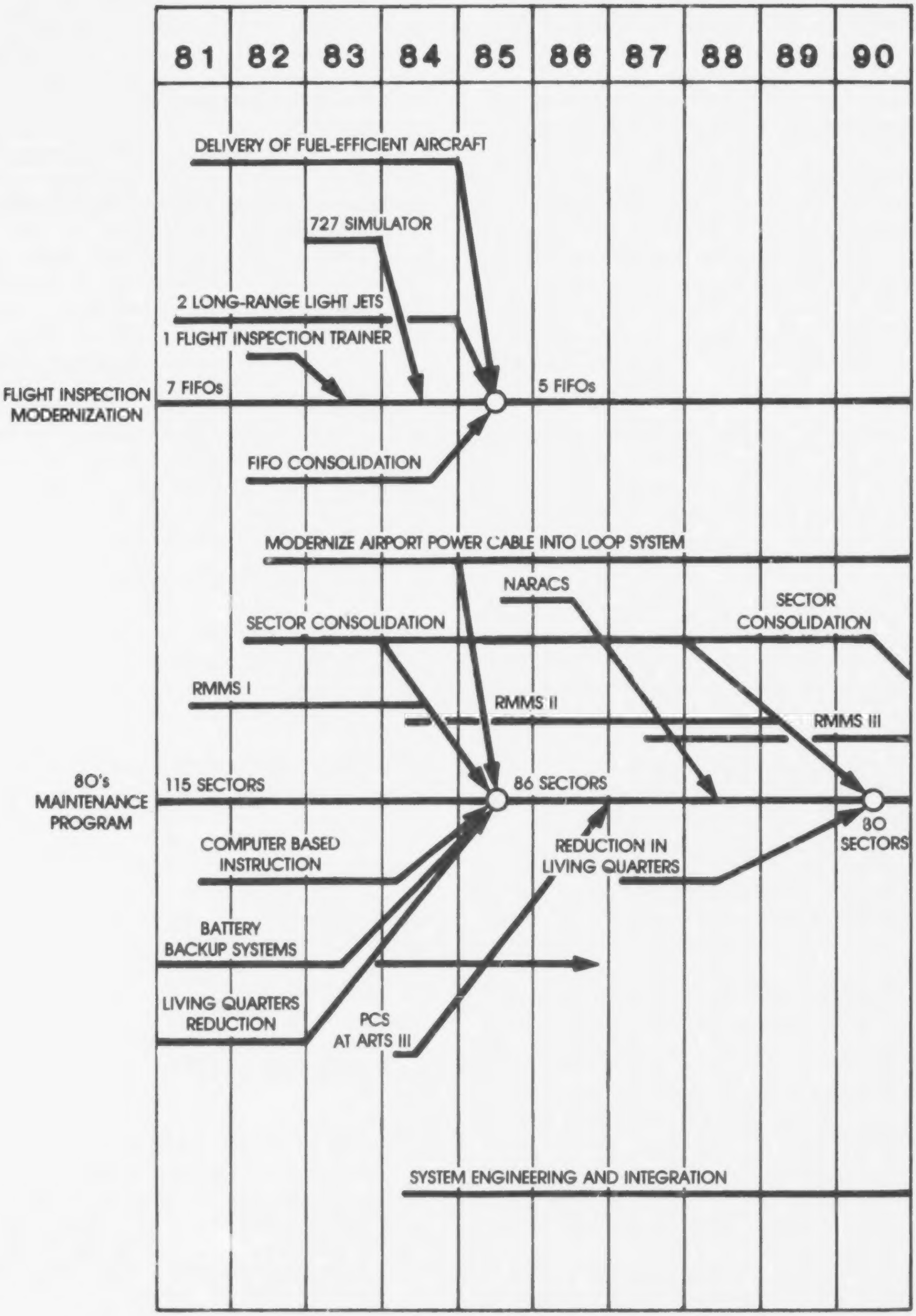
FAA-owned employee housing at isolated sites will be reduced from 23 to 3 locations in Alaska through remote monitoring and consolidation.

An emergency communications network will be in place by 1988. It will evolve from today's backbone networks as follows: By 1985, an eastern and western command network will interface with the backbone network. By 1990, regional networks will be added to complete the emergency communications networks.

Flight inspection field offices will be consolidated from seven to five. Upgraded avionics will be integrated into the fleet. Semiautomatic flight inpection will be eliminated and its function incorporated into an automatic flight inspection program. The fleet will be replaced by turboprop aircraft providing significant operating cost reduction. The number of flight inspection operations hours will be reduced from 27,000 hours annually in 1981 to 25,000 hours by 1985 and, finally, to 20,000 hours by 2000.

Computer-based instruction will be instituted for aircraft maintenance and flight inspection crew training as well as for some air traffic control refresher training.

The following diagram and maps describe the evolution of the system.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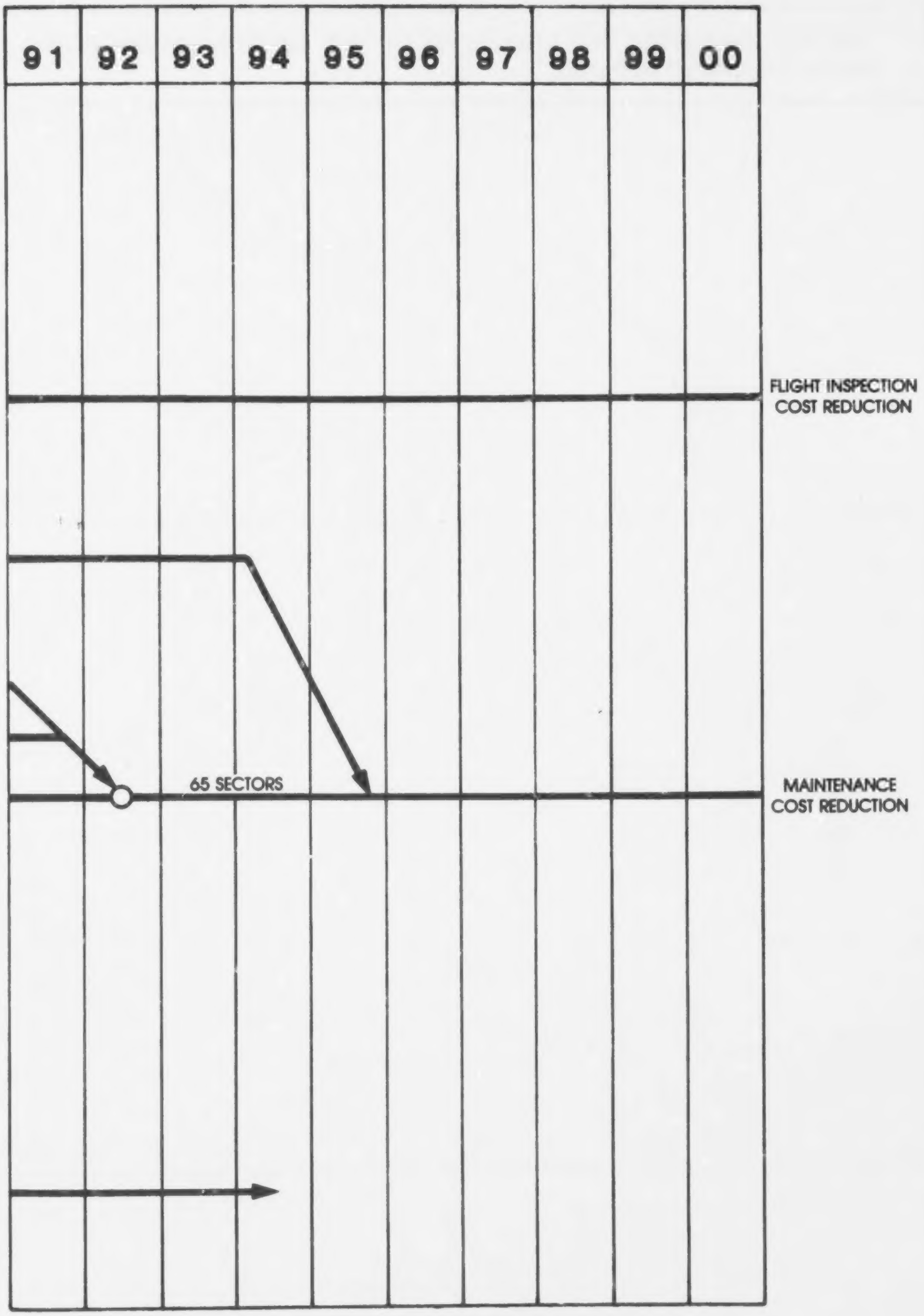
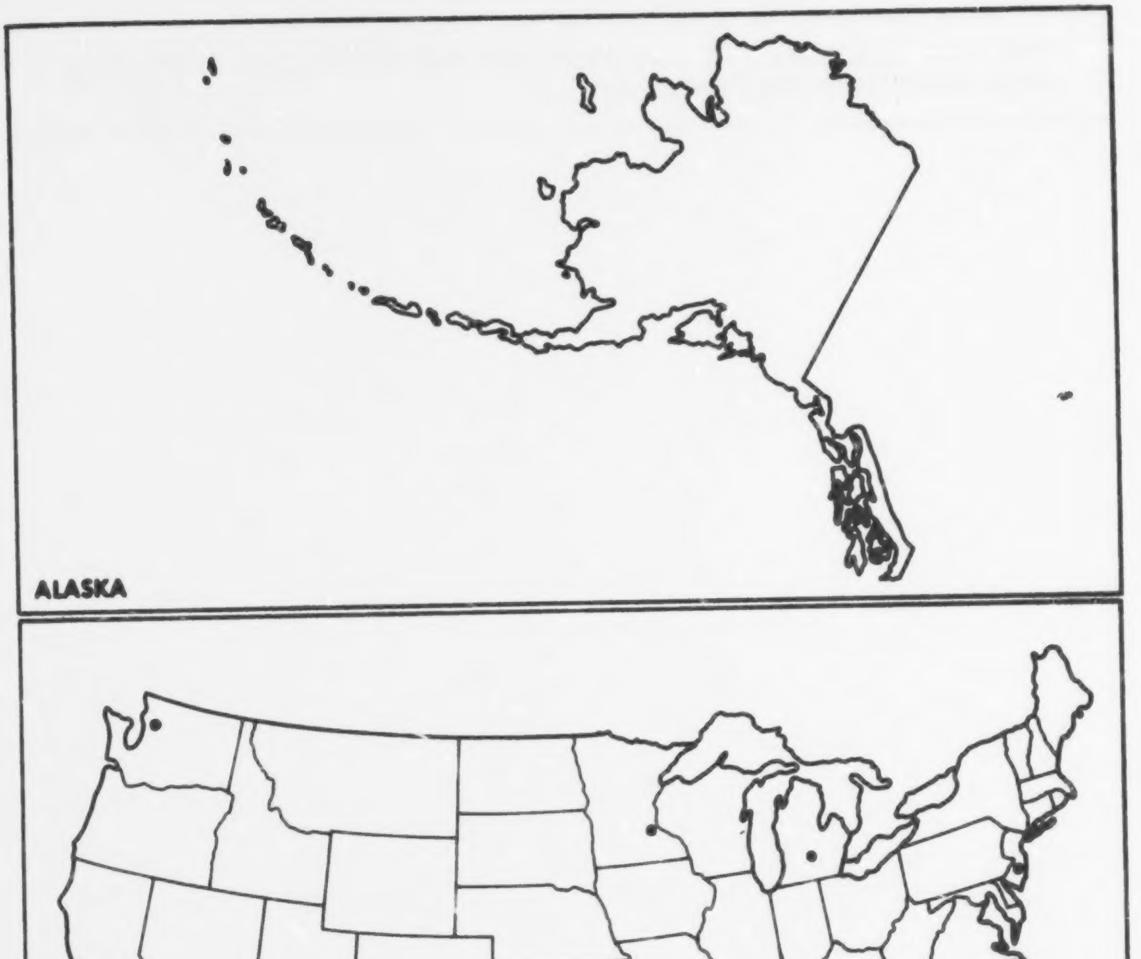
DELIVERY OF FUEL-EFFICIENT AIRCRAFT
727 SIMULATOR
2 LONG-RANGE LIGHT JETS
1 FLIGHT INSPECTION TRAINER
FLIGHT INSPECTION MODERNIZATION
7 FIFOs
5 FIFOs
FIFO CONSOLIDATION
MODERNIZE AIRPORT POWER CABLE INTO LOOP SYSTEM
NARACS
SECTOR CONSOLIDATION
SECTOR CONSOLIDATION
RMMS I
RMMS II
RMMS III
80's MAINTENANCE PROGRAM
115 SECTORS
86 SECTORS
80 SECTORS
COMPUTER BASED INSTRUCTION
REDUCTION IN LIVING QUARTERS
BATTERY BACKUP SYSTEMS
LIVING QUARTERS REDUCTION
PCS AT ARTS III
SYSTEM ENGINEERING AND INTEGRATION



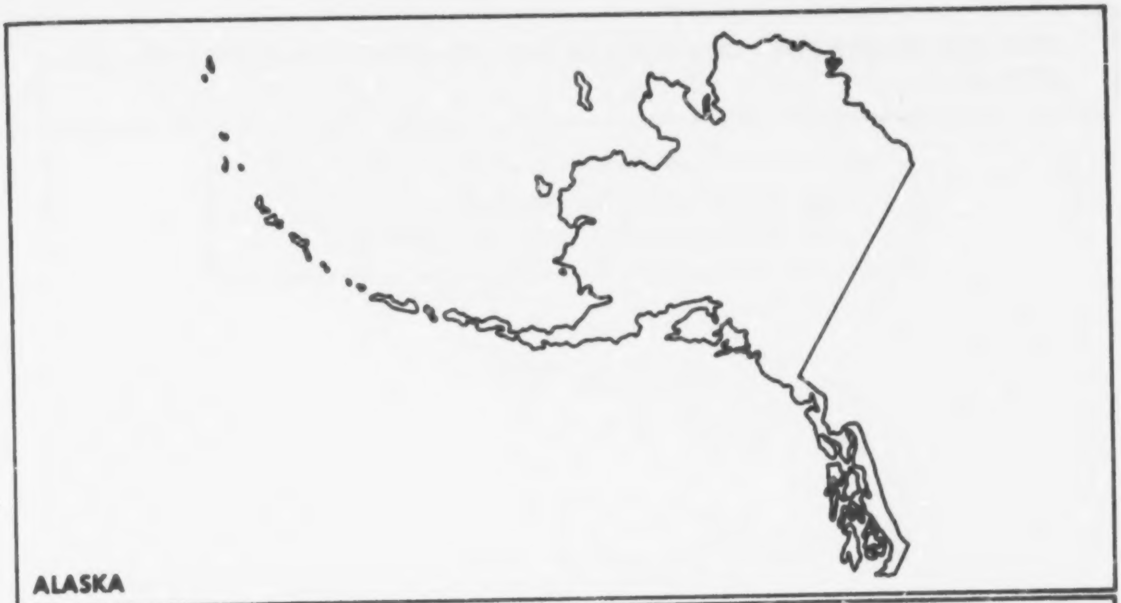
MAINTENANCE AND OPERATIONS SUPPORT SYSTEMS EVOLUTION

THIS MAP INDICATES THE LOCATIONS OF THE EXISTING SEVEN FLIGHT INSPECTION FIELD OFFICES.

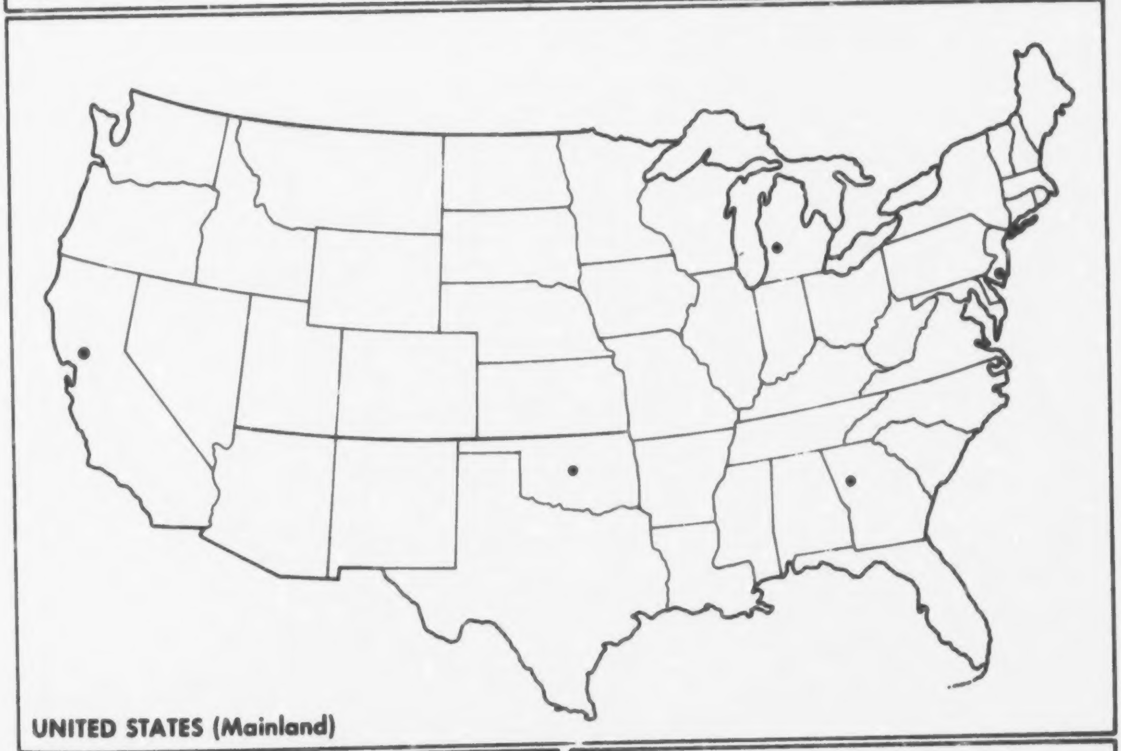

ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1981 SYSTEM
FLIGHT INSPECTION FIELD OFFICES

THIS MAP INDICATES THE LOCATIONS OF THE FIVE FLIGHT INSPECTION FIELD OFFICES AFTER CONSOLIDATION.

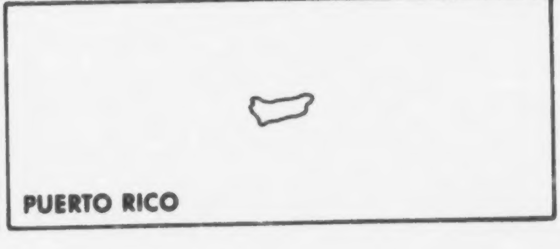


ALASKA



UNITED STATES (Mainland)

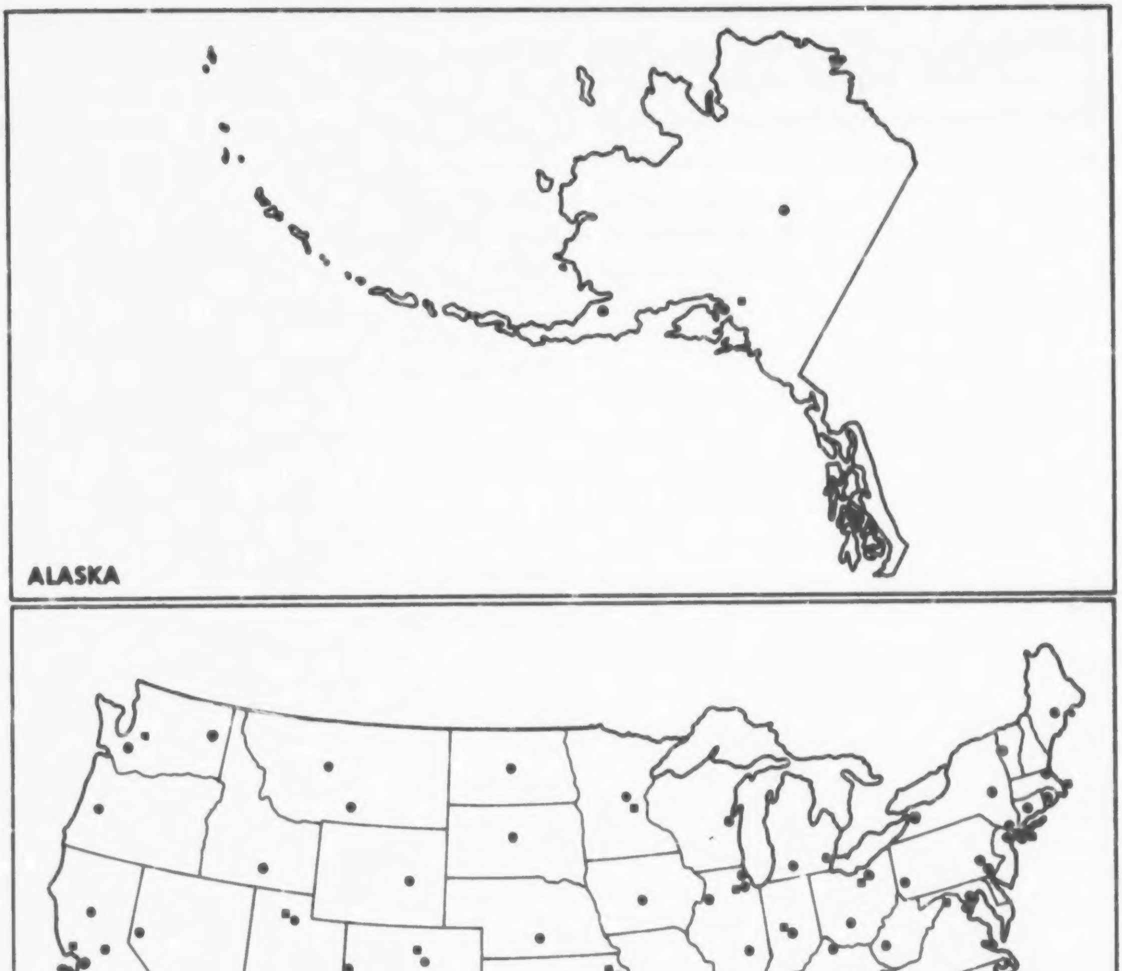
HAWAII



PUERTO RICO

THIS MAP SHOWS THE LOCATIONS OF THE 115 AIRWAY FACILITIES SECTOR OFFICES.

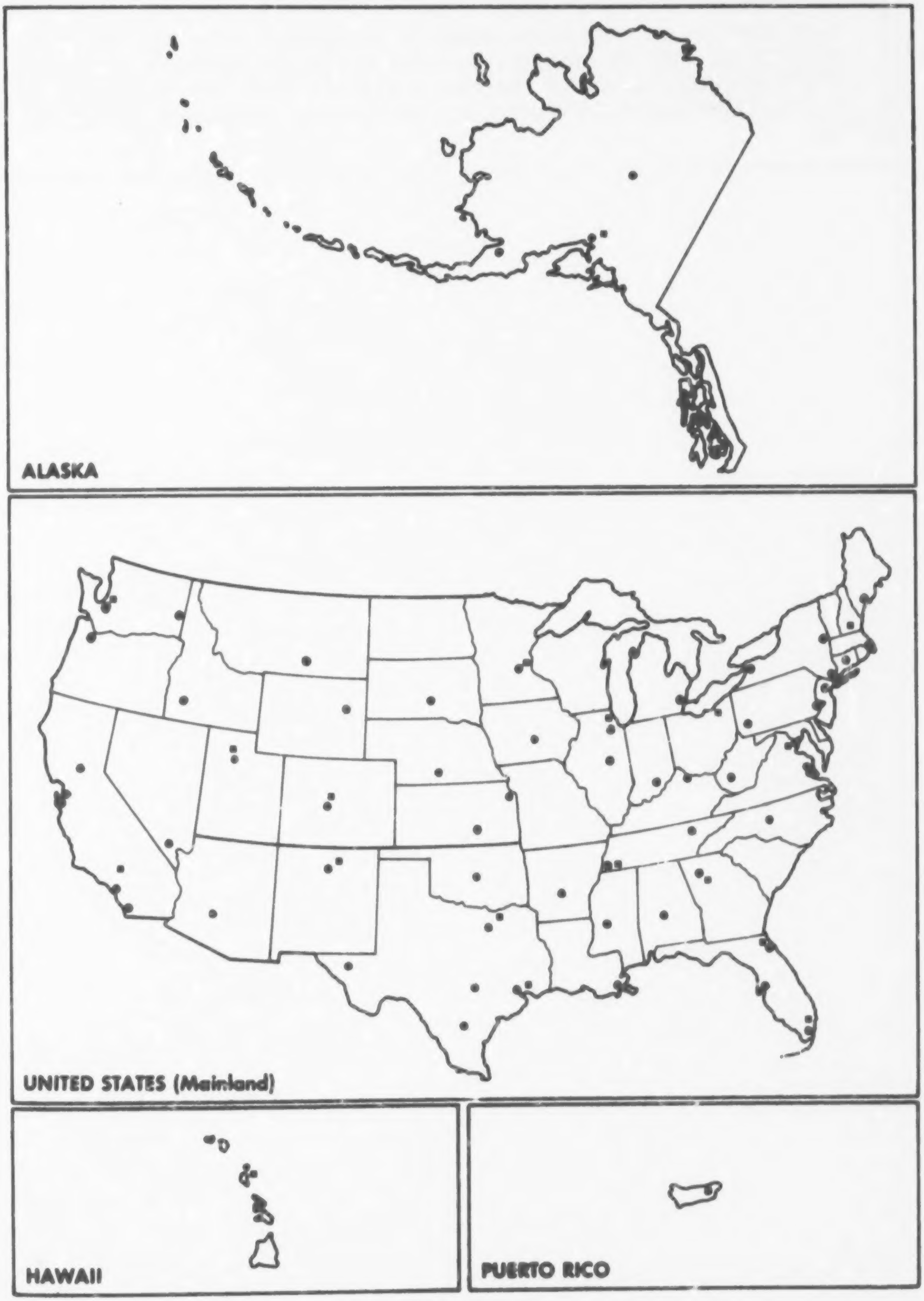
■ ARTCC SECTOR OFFICES
● GENERAL NAS SECTOR OFFICES


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1981 SYSTEM
AF SECTOR OFFICES

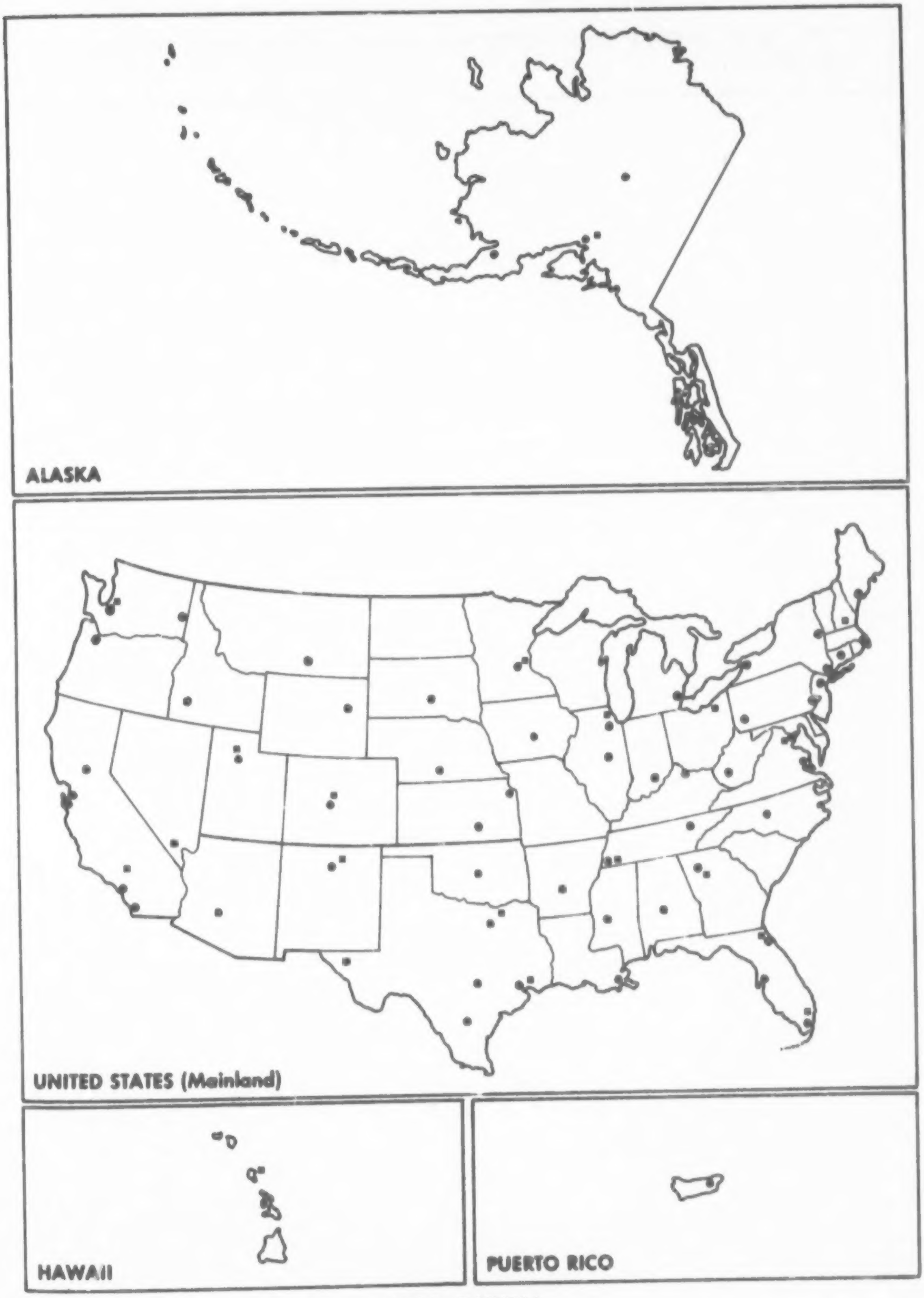
THIS MAP SHOWS THE LOCATIONS OF THE 86 AIRWAY FACILITIES SECTOR OFFICES. THE REDUCTION IS A RESULT OF CONSOLIDATION.

■ ARTCC SECTOR OFFICES
● GENERAL NAS SECTOR OFFICES


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

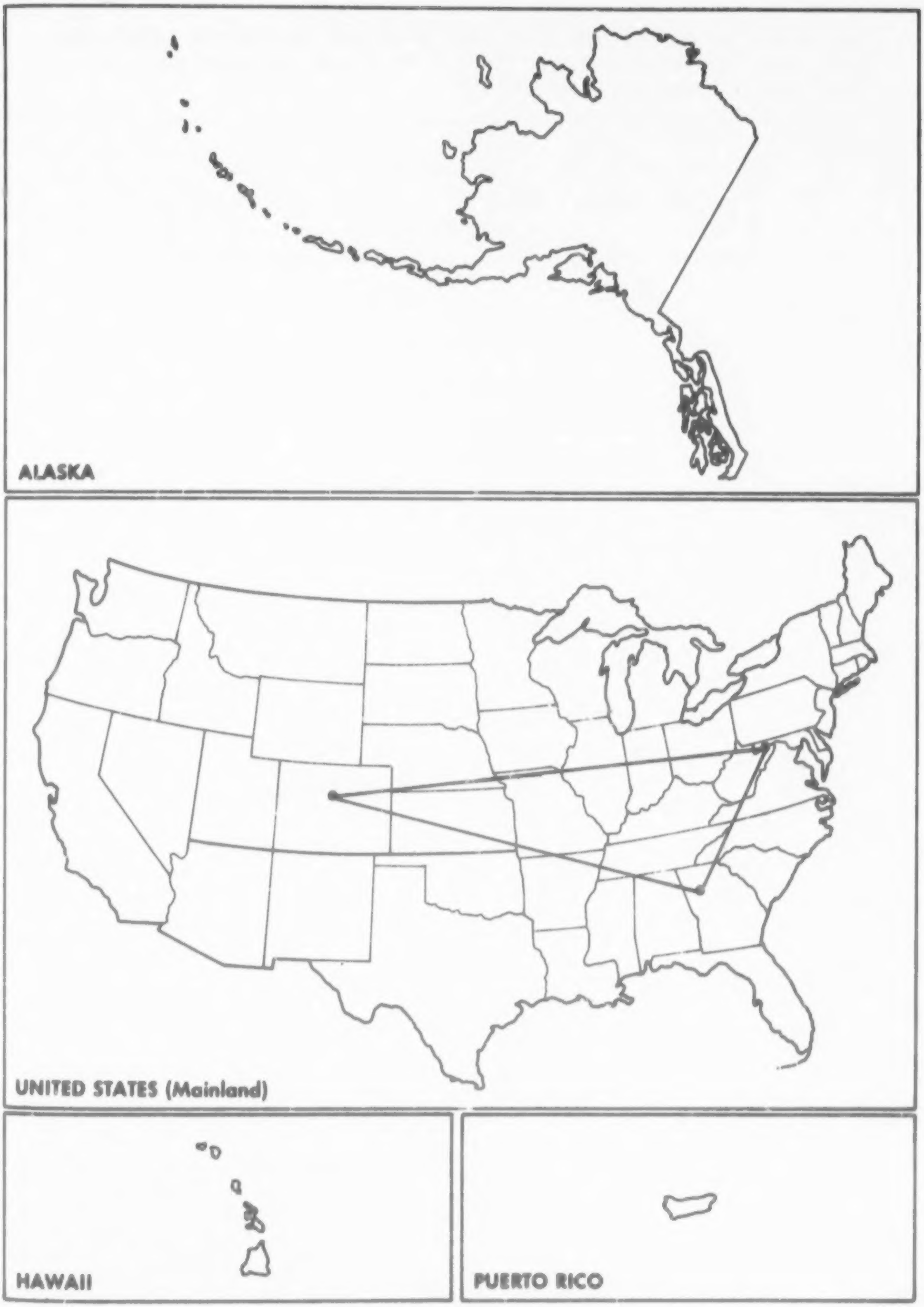
1985 SYSTEM
AF SECTOR OFFICES

THIS MAP SHOWS THE LOCATIONS OF 80 AIRWAY FACILITIES SECTOR OFFICES. IN 1990 THE REDUCTION IS DUE TO CONSOLIDATION RESULTING FROM IMPLEMENTATION OF THE MAINTENANCE PROGRAM FOR THE 1980's. BY THE YEAR 2000, FURTHER CONSOLIDATION WILL REDUCE THE TOTAL TO 65.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1990 SYSTEM
AF SECTOR OFFICES

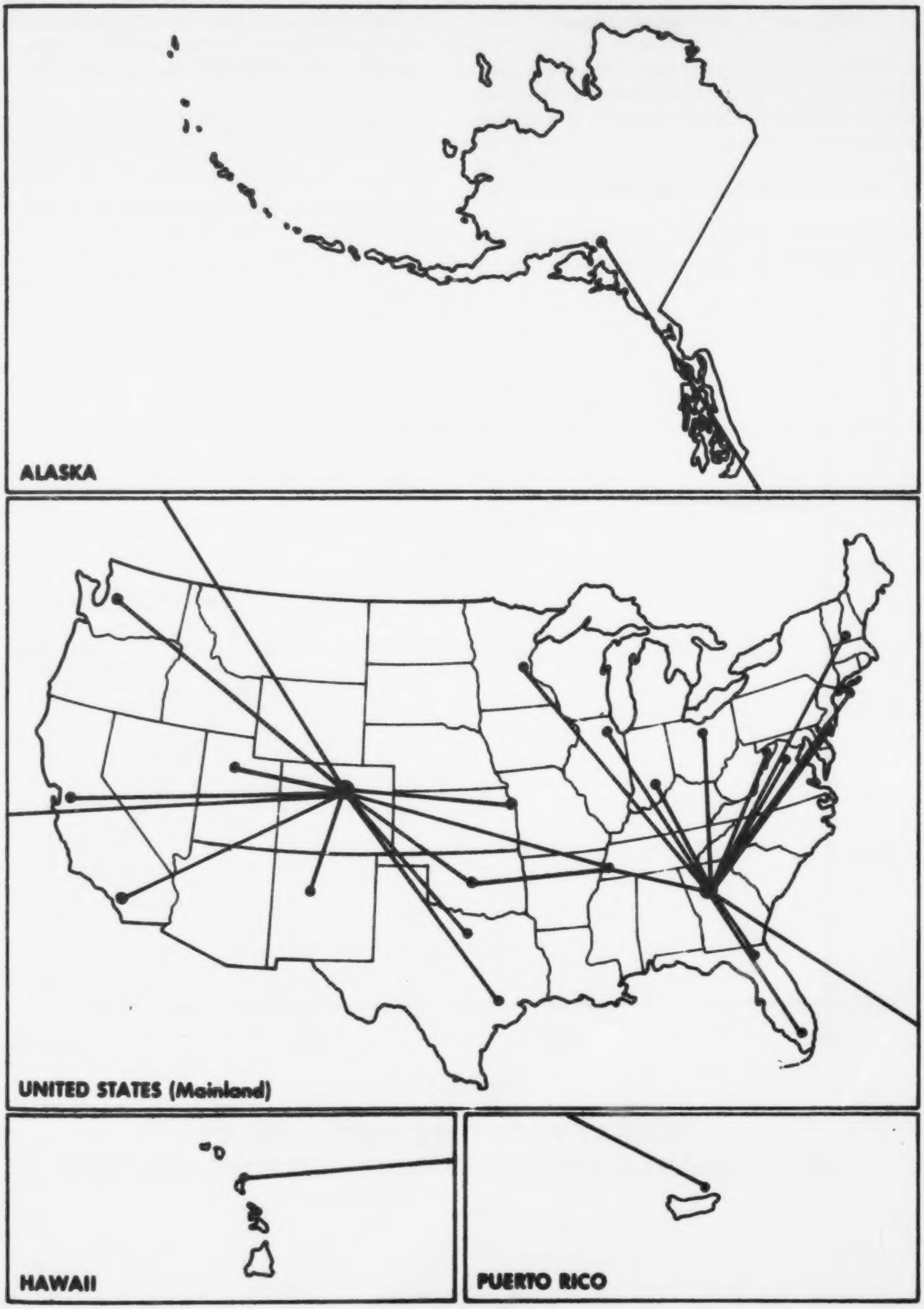
THIS MAP SHOWS THE EXISTING SIMPLE VOICE HIGH-FREQUENCY NETWORK.


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1981 SYSTEM
NATIONAL EMERGENCY COMMUNICATIONS SYSTEM

THIS MAP SHOWS THE EASTERN AND WESTERN NETWORKS COMBINED WITH THE HIGH-FREQUENCY NETWORK TO FORM THE NATIONAL RADIO EMERGENCY COMMUNICATIONS SYSTEM.

● AIR ROUTE TRAFFIC CONTROL CENTERS (ARTCC)


ALASKA
UNITED STATES (Mainland)
HAWAII
PUERTO RICO

1985 SYSTEM
NATIONAL RADIO COMMUNICATIONS SYSTEM

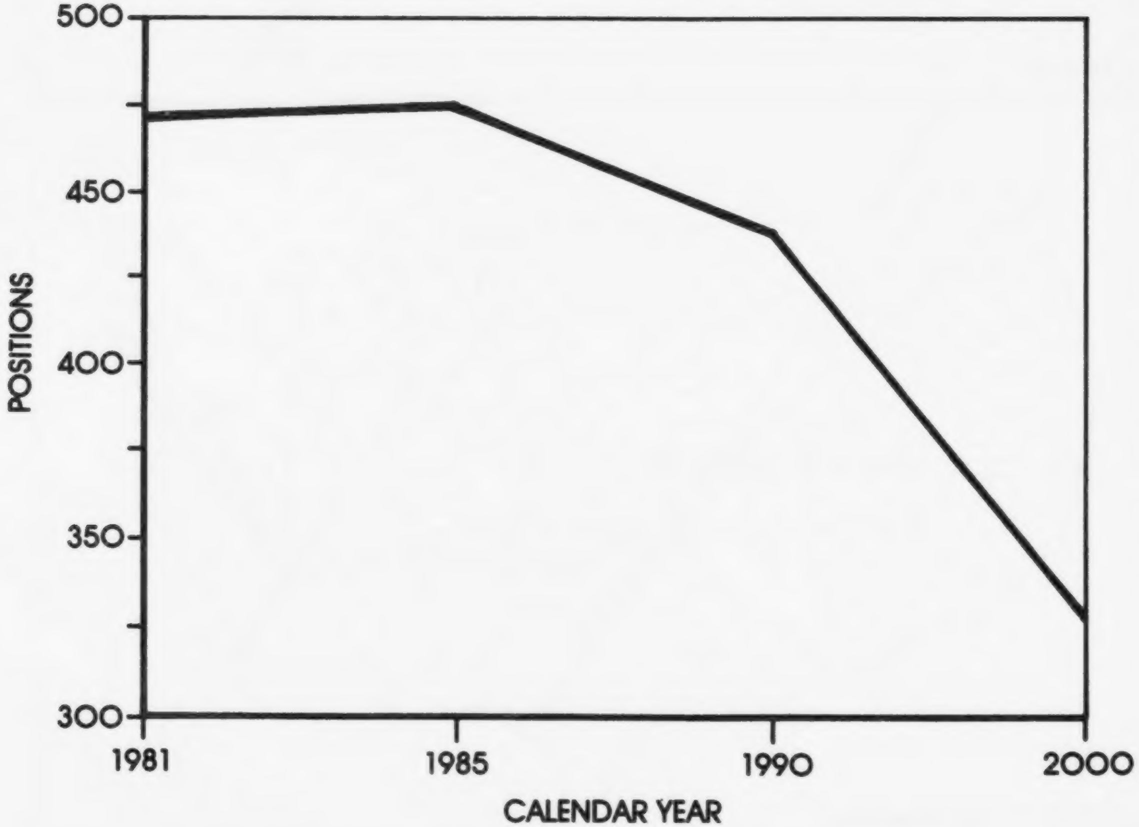
RETURN ON THE INVESTMENT

As a result of these planned actions, FAA will be able to provide a variety of new and improved services with significant reductions in both staffing and operating costs.

FIELD EMPLOYMENT

Employment levels reflect Airway Facilities sector manager and subordinate positions required to staff the maintenance and operations support system. Air Traffic, FAA Academy, and national field support group staffing is not included in this system.

During the next 20 years, the maintenance and operations support system will undergo changes in hardware and plant improvement. These will result in changes within Airway Facilities as shown in the chart below.



AIRWAY FACILITIES EMPLOYMENT
(MAINTENANCE AND OPERATIONS SUPPORT SYSTEMS)

These programs will have the net effect of decreasing current Airway Facilities employment requirements at FAA field facilities by 29 percent by the year 2000.

Airway Facilities in 1981 had 473 employees supporting the maintenance program. Through 1985, staffing will remain constant.

During the period to 1990, employment decreases with the modernization of unmanned facilities, expanded use of RMM, and less reliance on engine generators for standby electric power.

Later staffing changes through the year 2000 are a result of the full implementation of RMM for airport and remote facilities. This will also permit FAA-owned family housing quarters to decrease. Full implementation of RMM and the consolidation of facilities will allow a significant reduction in the number of Airway Facilities sectors and field office staffing. The maintenance and operations support system will require 327 positions.

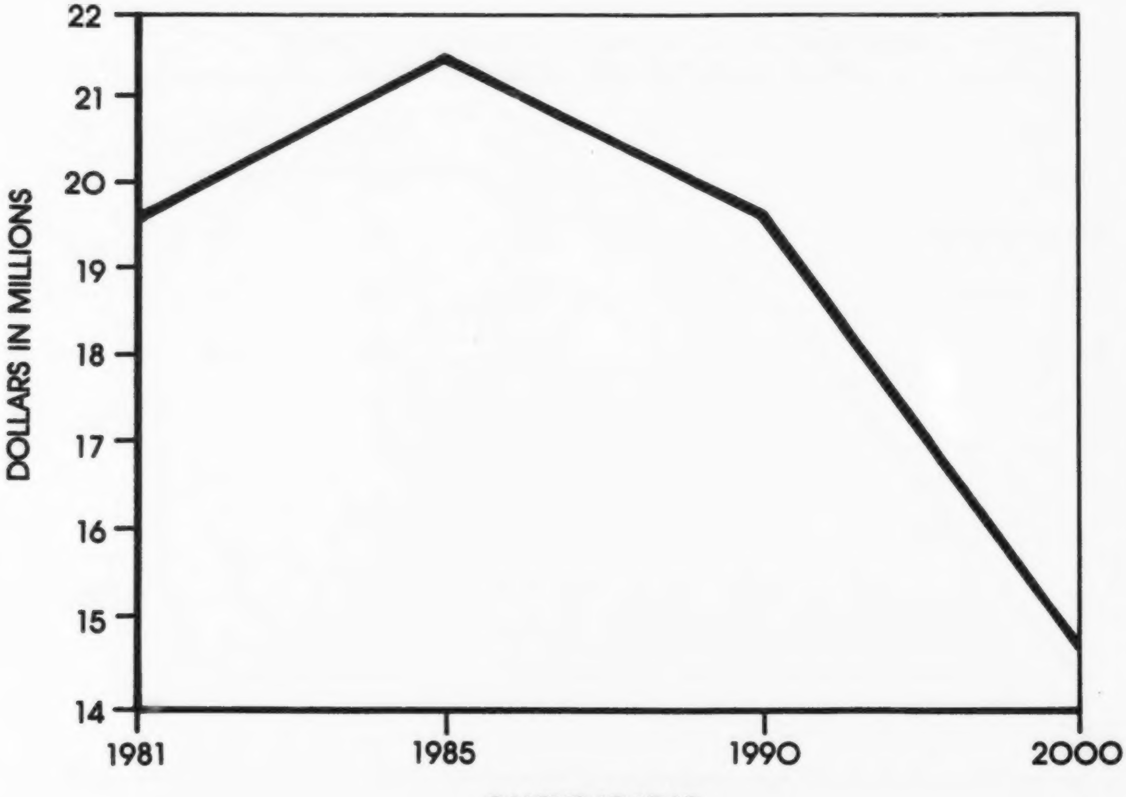
MAINTENANCE AND OPERATIONS SUPPORT SYSTEMS AIRWAY FACILITIES EMPLOYMENT CHANGES

	1981	1985	1990	2000
No. of Facilities	4,600	4,602	3,977	3,226
Airway Facilities Personnel	473	475	434	327
AF Productivity Quotient	9.7	9.7	9.2	9.9
Total AF Staffing	473	475	434	327

FIELD OPERATIONS COSTS

Total operating costs include estimated annual expenditures for personnel, rents and utilities, and other miscellaneous categories. The costs for each of the year are a direct consequence of the facility changes and their impact in these areas. Costs are in constant FY-81 dollars.

Airway Facilities personnel costs are derived by multiplying the total number of employee-years associated with the maintenance of field equipment by the average cost of an electronics technician in 1981: $34,100. A single cost figure has been used here due to the current composition of the AF work force and the expectation that trainee technicians and administrative positions will remain small compared to the overall field work force. These costs are summarized at the end of this section.



OPERATIONS COSTS

Rents and utilities designate the estimated annual expenditures for renting equipment, land, and buildings; local telephone service; electric, gas, and water service; etc.

Other services not otherwise classified, such as storage of household goods, automotive maintenance and repair, aircraft rental, repair of technical building facilities and grounds, etc., are included here.

MAINTENANCE AND OPERATIONS SUPPORT SYSTEMS OPERATIONS COSTS (000)

	1981	1985	1990	2000
Airway Facilities Personnel	16,129	16,198	14,799	11,151
Rents & Utilities	1,734	2,198	2,011	1,514
Other	1,774	3,067	2,806	2,112
Totals	19,637	21,463	19,616	14,777

SUMMARY OF CHANGES

During 1985-2000, energy consumption will decrease as the number of facilities decreases.

MAINTENANCE AND OPERATIONS SYSTEMS ENERGY DATA

	1981	1985	1990	2000
Energy (kWh × 10^6)	24	19	16	12
Costs (Millions)	1.25	0.95	0.80	0.60

SPECIFIC PROJECTS

The plan calls for 18 separate projects to modernize maintenance and operations support systems. The 1983 edition project titled Traffic Management System Automation Facility has been completed.

PROJECTS	IMPLEMENTATION	
	FIRST	LAST
MAINTENANCE IMPROVEMENTS		
1. Remote Maintenance Monitoring System (RMMS)	1980	1992
2. Computer Based Instruction (CBI)	1982	1985
3. Central Repair Facility (CRF)	1985	1986
4. Maintenance Control Center (MCC)	1985	1988
POWER IMPROVEMENTS		
5. Airport Power Cable Loop Systems	1985	1995
6. Power Conditioning Systems for Automated Radar Terminal Systems III (ARTS III)	1984	1986
7. Power Systems	1981	2000
STRUCTURES IMPROVEMENTS		
8. Unmanned FAA Airway Facilities Buildings and Plant Equipment	1983	2000
9. ARTCC Plant Modernization	1985	1988
10. Acquisition of Flight Service Facilities	1982	1988
AIRCRAFT IMPROVEMENTS		
11. Aircraft Fleet Conversion/Flight Inspection Modernization	1981	1986
12. Aircraft and Related Equipment	1984	1989
SYSTEM IMPROVEMENTS		
13. System Engineering and Integration Contract	1984	1994
14. National Radio Communications System (NARACS)	1983	1988
15. NAS Spectrum Engineering	1982	2000
16. General Support	1982	2000
17. System Support Laboratory	1983	2000
18. General Support Laboratory	1983	2000

PROJECT SUMMARY

PROJECT 1: Remote Maintenance Monitoring System (RMMS)

Purpose: This project will provide monitoring and control equipment for FAA facilities so that equipment performance monitoring, control, and certification can be accomplished from work centers. Remote maintenance monitoring will permit staffing reductions and consolidation, improve quality of worklife, improve work force utilization, and increase work force productivity. When fully implemented, remote maintenance monitoring will permit substantial savings in operations cost and manpower.

Approach: Establish a network of maintenance processor subsystems (MPS) at ARTCCs and general NAS sectors. Provide standardized remote monitoring subsystems (RMS) and incorporate these into existing solid-state systems whenever cost-effective. Assure that newly acquired systems incorporate remote monitoring and control features and interface with the RMM network. Existing communication lines will be utilized initially for MPS-to-RMS and MPS-to-MPS data transfer. The FAA's telecommunications network will be used for eventual transmission and switching.

Products:

- Phase I (underway) provides the basic RMM network consisting of 25 en route MPSs (22 installed through December 1983; last delivery in March 1984), RCAG RMSs, second-generation VORTAC RMSs, and fixed and portable terminals for work centers and other field stations. It will also include tube-type, long-range radar limited remote control units. Phase I includes the first elements of the maintenance management system (MMS), a hardware and software expansion of the MPSs to permit automated recordkeeping and outage reporting, trend analysis, and other technical and administrative functions.

- Phase II will include 65-86 general NAS sector MPSs with maintenance management software, RMS for airport related facilities, DVOR RMSs, ARSR 3 RMSs, RMSs for navigation and communications facilities associated with FSSs, and the expansion of the en route MPSs to accommodate the additional RMSs.

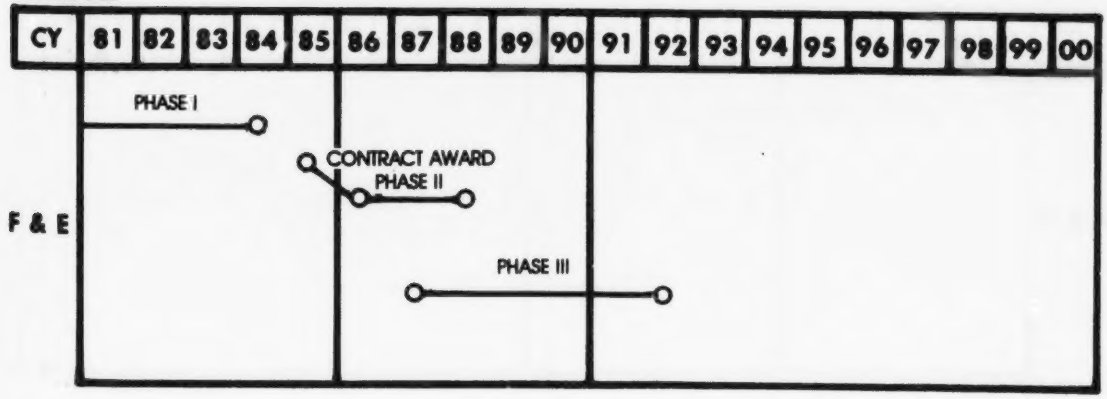
- Phase III will consist of enhancements of the RMMS such as adding uplink command and adjustment capabilities, remote diagnostics, and other features geared to reduce the frequency of onsite maintenance visits. During this phase, RMSs that are part of new systems (e.g., ASR 9, Mode S, MLS, etc.) will be integrated.

Related Projects/Activities: All NAS systems that will tie into the RMM network, FAA telecommunications network, RML Replacement and Expansion.

SCHEDULE

CY	81	82	83	84	85.	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

SCHEDULE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PHASE I
CONTRACT AWARD
PHASE II
F & E
PHASE III

PROJECT 2: Computer Based Instruction (CBI)

Purpose: This project will provide high quality, cost-effective training of FAA personnel. CBI will also provide a cost-effective method of providing proficiency training. This is a new training requirement that must be provided because of the high reliability of our new equipment and the new maintenance philosophy.

In some cases, CBI will be coupled with specific hands-on equipment training at the FAA Academy. Whenever possible, CBI will be used at local or field sites and will form the nucleus of field-conducted training. New instructional technologies will be evaluated for potential benefit as an approved approach for accomplishing CBI training.

CBI promotes the accomplishment of the agency mission by:

- Significantly reducing the current travel costs associated with centralized training.
- Improving the efficiency and productivity of facility training staffs.
- Providing flexibility in scheduling and conducting training according to the individual's unique needs.
- Allowing for greater local management control of the training schedules and resources.
- Making onsite proficiency/update training more widely available.
- Fostering improvements in employee productivity.

Approach: Establish CBI learning centers where there are large concentrations of field personnel, including sector offices, ARTCCs, towers, flight inspection field offices, and regional offices.

During 1981-1983, a limited number of Airway Facilities courses were developed and provided at 60 field locations. Additional high-volume technical courses will be available in 1984, 1985, and 1986 at Air Traffic, Airway Facilities, and Flight Standards field sites.

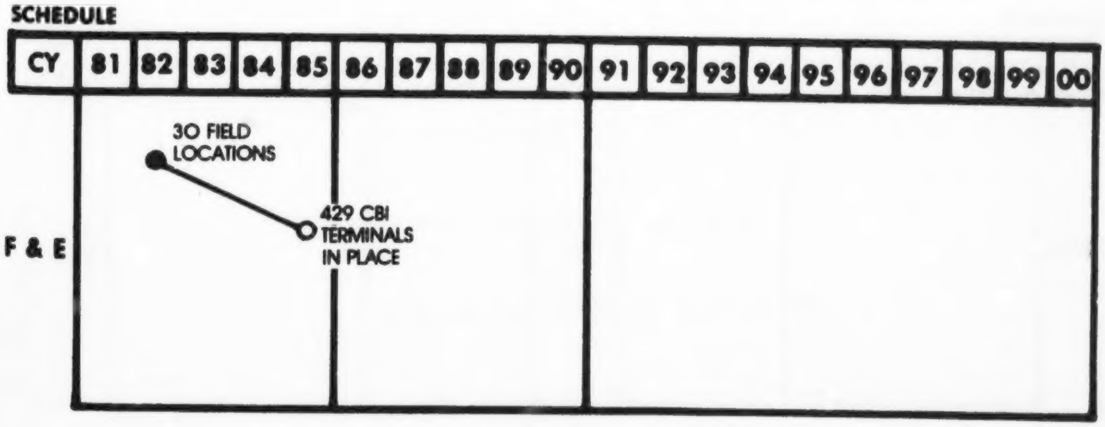
Products: By 1985 there will be a total of 429 CBI terminals.

• Airway Facilities sectors offices	128
• Flight inspection offices	7
• ARTCC	150
• Airport traffic control towers, levels IV & V	83
• FAA Academy	49
• Regions/centers/Washington headquarters	12

Related Projects/Activities: With the many technological improvements being made in the computer based instruction field and other innovative methods of instruction being developed, a continuing study of these changes is being conducted by the Program Engineering and Maintenance Service (APM)/Office of Personnel and Training (APT)/Aeronautical Center (AAC). We anticipate the need to upgrade each CBI training center at a minimum of 7-year intervals.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				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F & E
30 FIELD LOCATIONS
429 CBI TERMINALS IN PLACE

PROJECT 3: Central Repair Facility (CRF)

Purpose: The Maintenance Program for the 1980's requires onsite repair be limited to the replacement of lowest replaceable units (LRU), lamp and fuse replacement, and repair of those units that cannot reasonably be replaced and repaired at a central location. To satisfy that requirement, it is necessary to establish central repair facilities.

In addition to LRU repair and adjustment, it is anticipated that test equipment repair and calibration will be accomplished at the CRF. The CRF may also become a part of Depot storage for LRU as well as storage for repair piece parts.

Space, special tools, furniture, diagnostic software for existing automated test equipment, and a test equipment calibration laboratory will be provided at each location.

Approach: A CRF is being established in each region as a part of the lead sector program. These nine CRFs will be used to establish the following concepts, procedures, and requirements:

- Number.
- Staffing.
- Space requirements.
- Training.
- Type and level of repair.
- Logistic support requirements.
- Type and number of support equipment required.

Products: By 1986 there will be CRFs at nine general NAS sectors.

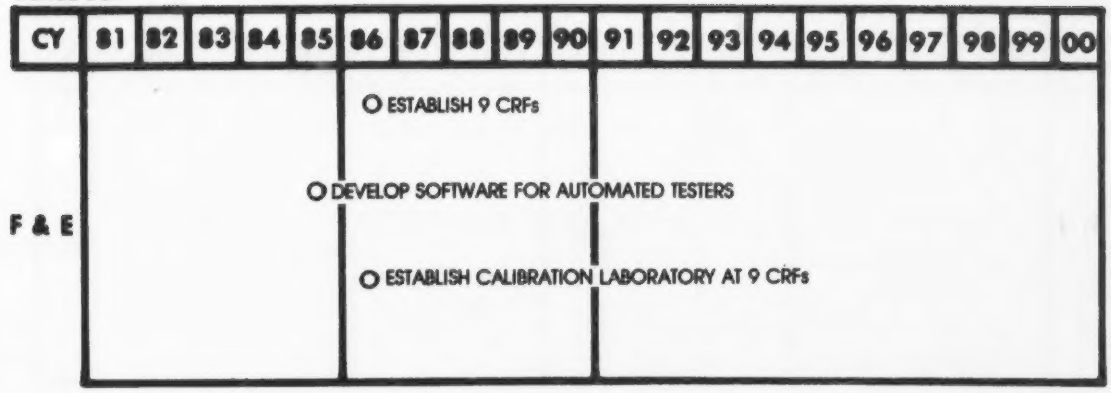
Related Projects/Activities: Maintenance Control Center, lead sector program, remote maintenance monitoring.

This project, although new to this edition, expands the concepts associated with the Maintenance Program for the 1980's in the 1983 edition.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

SCHEDULE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F & E
ESTABLISH 9 CRFs
DEVELOP SOFTWARE FOR AUTOMATED TESTERS
ESTABLISH CALIBRATION LABORATORY AT 9 CRFs

PROJECT 4: Maintenance Control Center (MCC)

Purpose: This project will improve the productivity of the field technical work force. The Maintenance Program for the 1980's requires that facilities be remote maintenance monitored utilizing personnel located at central maintenance facilities. From these work centers, system monitoring and routine maintenance will be performed, or personnel dispatched for corrective maintenance of the new generations of highly reliable solid-state systems. The maintenance control center will be the focal point for these activities. It will provide continuous monitoring for all remote facilities through the use of the RMM network; act as the central communications point; and provide the capability to effectively dispatch, redirect, and manage the sector's work force from the central maintenance facilities. The maintenance processor system will normally be placed at this location.

Approach: A maintenance control center (MCC) is being established in lead sectors as a part of the lead sector program. Lead sector engineering studies shall be evaluated to establish procedures and finalize requirements for:

- Training.
- Certification.
- Communications.
- Hours of operation.
- Staffing requirements.
- Administrative support.
- Space requirements.

Products:

- In 1984 engineering studies will be completed.
- By 1985 there will be nine MCCs established (one per region).
- By 1988 an MCC will be established at each sector office or other suitable location.

Other products include the establishment of uniform functions and operating procedures; consistent training, certification, shift, and space requirements; and the ability to effectively direct and utilize our technical work force.

Related Projects/Activities: Central Repair Facility, lead sector program, remote maintenance monitoring.

This project, although new to this edition, expands the concepts associated with the Maintenance Program for the 1980's in the 1983 edition.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
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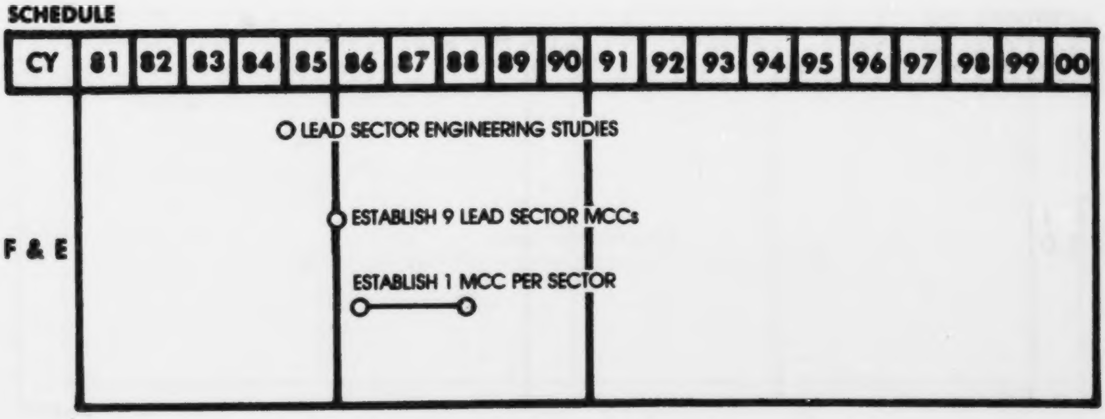
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LEAD SECTOR ENGINEERING STUDIES
ESTABLISH 9 LEAD SECTOR MCCs
ESTABLISH 1 MCC PER SECTOR

PROJECT 5: Airport Power Cable Loop Systems

Purpose: This project will establish a reliable and flexible power distribution system for airports.

Cables at many airports are 25 to 30 years old and are approaching the point where replacement is necessary for reliable operation. Reliable power distribution will be provided through the replacement of deteriorating cables at major airports and the reconfiguration of them into loop systems.

The installation of power cable loop systems will:

- Eliminate outages caused by deteriorating or failing cables.
- Allow cable repair with minimum outages.
- Allow for better planning of airport cable systems.
- Permit cost-effective installation of fiber optic signal and control cables in the same trench or duct.

Approach: Each region will develop a master plan for the cable systems on each of its major airports, which accommodates power and telecommunication needs.

The master plan will provide for the replacement of obsolete, independent, radially installed cables with new cables and switches installed in a loop configuration. Emphasis will be on reliability and flexibility. New cable installations will be designed to provide for future growth and capacity.

Co-location of the power and fiber optic control and communication cables will provide compatibility with remote maintenance monitoring and redundancy for all operational functions.

Outage time resulting from cables damaged accidentally by animals or environmental factors will be minimized through fault sensing and switching of power, communication, and control cables.

Products:

- More reliable and flexible power distribution systems at 100 airports.
- Power loop standards.

Related Projects/Activities: Microwave landing system, facility consolidation, remote maintenance monitoring, and airport telecommunications.

This project appeared in the 1983 edition in chapter VI under Modernize Airport Cables into Loop System.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
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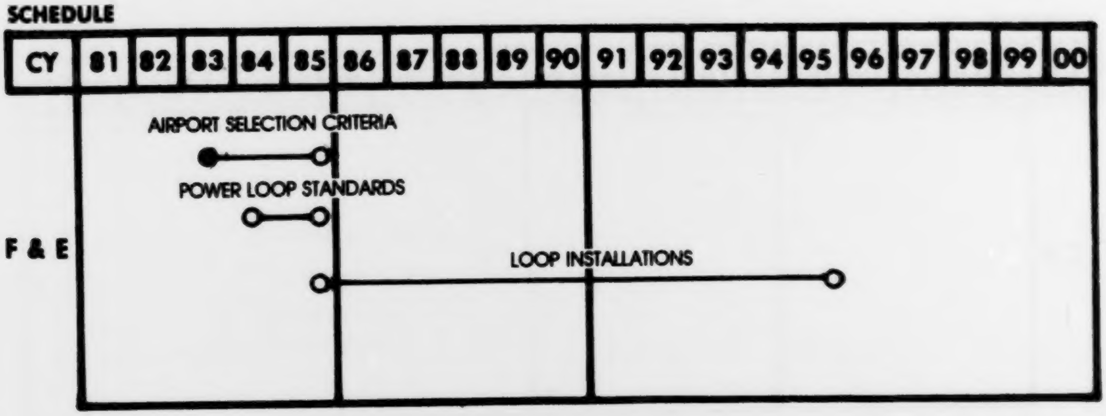
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F & E
AIRPORT SELECTION CRITERIA
POWER LOOP STANDARDS
LOOP INSTALLATIONS

PROJECT 6: Power Conditioning Systems for Automated Radar Terminal Systems III (ARTS III)

Purpose: Medium- and high-activity terminals are provided with standby power that limits interruptions to a maximum of 15 seconds. However, the ARTS III equipment used at these locations is sensitive to small power transients and may go into a "save data" mode (frozen display) even when perturbations are not sufficiently long to require standby power. For standby power to be activated, the utility must be 10 percent below rated voltage for 2 seconds; whereas, ARTS III may go into a momentary "save data" mode if power is out of tolerance for 17 milliseconds. The ARTS IIIA may require 30 to 45 seconds to restore operation after return of acceptable power.

This program will increase the reliability of electrical power so that it will approach 100 percent availability. The installation of PCS in the ARTS III facilities will increase operational reliability and reduce operational downtime.

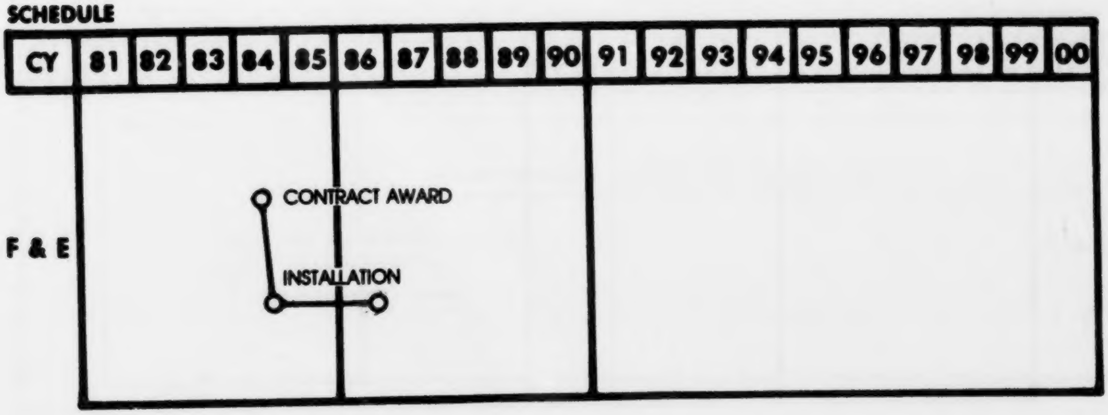
Approach: Provide PCS to ensure that stable electrical power with precisely regulated voltage and frequency characteristics is continuously available for the operation of vital equipment. The equipment will be similar to the PCS/uninterrupted power source (UPS) currently located at offshore EARTS locations, the Atlanta aviation weather and NOTAM system (AWANS), and dual and triple RML facilities.

Products: 60 commercially available, off-the-shelf power conditioning systems.

Related Projects/Activities: Area Control Facilities, Advanced Automation System.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				



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CONTRACT AWARD
INSTALLATION

PROJECT 7: Power Systems

Purpose: The project will provide the optimum type and quality of electrical power necessary to ensure high facility availability and reliability and reduce operating costs and energy consumption of standby power systems at unmanned facilities.

Standby power at unmanned facilities is almost entirely provided by engine generators. Vacuum-tube technology imposed demands for standby power sources best satisfied by engine generators. New electronics technology results in significant reductions in its energy consumption and related environmental support systems. New long-life (20 to 30 years) batteries are a practical alternative to the smaller engine generators. Battery standby power systems provide for increased facility availability, reduced operating costs, and reduced overall energy consumption.

Many FAA structures and facilities do not have lightning protection systems installed. Existing systems are marginal. In addition, some facilities have obsolete wiring and inadequate grounding, bonding, and shielding. Lightning surge protection devices must be improved at many facilities and deficiencies in wiring, grounding, bonding, shielding, and code violations must be corrected.

In the future facilities will be unmanned and may normally be operated at lower temperatures in cold weather and higher temperatures during hot weather. Environmental control centers provide a means to save energy by raising or lowering temperature during site visits by maintenance personnel.

Approach: Develop a national plan to improve power and environmental systems for unmanned facilities. Modifications will be made to standby power systems (replacement of small engine generators with batteries and dc distribution systems) and power transfer systems. Large engine generators will be overhauled or replaced. Remote maintenance monitoring systems will be utilized to permit monitoring, certification, and control. Approximately 2,500 smaller engine generators (30 kW and below) will be replaced with batteries and dc distribution systems starting at the rate of 120 per year. Approximately 600 engine generators will be overhauled or replaced. Other commercially available power sources will be introduced for use in the FAA as standby power sources.

Lightning surge protection and grounding, bonding, and shielding efforts will be continued to upgrade existing equipment to the latest state-of-the-art. Modification kits will be fabricated to correct other known deficiencies. Obsolete wiring will be replaced and facilities will meet code requirements. Lightning protection shall be provided for approximately 150 RCAGs, 80 ATCTs, and 100 miscellaneous facilities while surge protection shall be provided at ILSs, RTRs, ARSRs, and high-frequency cables (including coaxial) at various installations. Grounding, bonding, and shielding will be provided at 23 ARTCCs, 160 ARTS, and 150 miscellaneous facilities.

The environmental control center has been designed and will be implemented. RMM equipment will also be provided for remotely located power and environmental equipment.

SCHEDULE

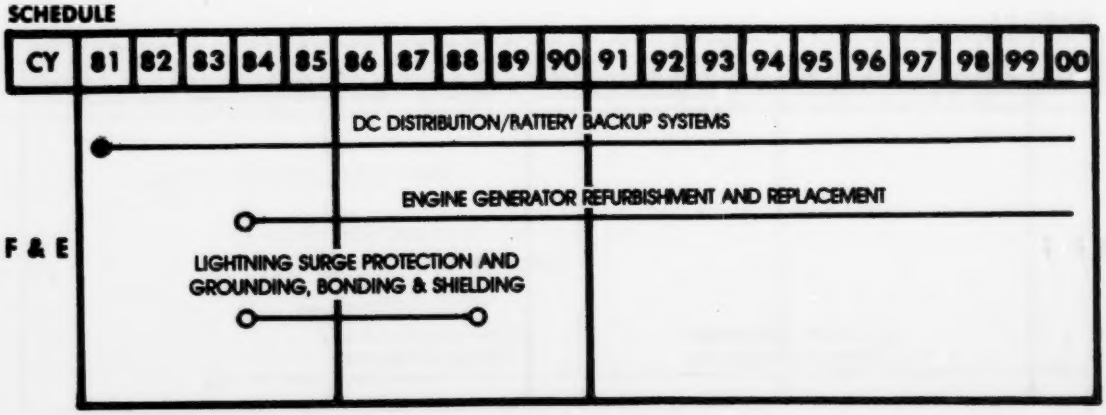
CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

This project and the Unmanned FAA Airway Facilities Buildings and Plant Equipment project are closely coupled. Electrical and mechanical systems work described herein will be completed in consonance with the Unmanned FAA Airway Facilities Buildings and Plant Equipment project.

Products: Battery/dc distribution systems will replace approximately 2,500 small-sized (30 kW and below) engine operators. Obsolete wiring will be replaced at unmanned facilities to meet code requirements. Lightning protection for approximately 150 RCAGs, 80 ATCTs, and 100 miscellaneous facilities. Surge protection for ILSs, RTRs, and ASRs. Grounding, bonding, and shielding at 23 ARTCCs, 160 ARTS, 150 miscellaneous facilities. RMM equipment for environmental equipment which enables control, monitoring, and certification from a remote point.

Related Projects/Activities: Communication facilities consolidation, unmanned FAA facilities modernization, and the remote maintenance monitoring program.

This project appeared in the 1983 edition under the title Modernize and Improve Unmanned FAA Airway Facilities Buildings and Equipment.



PROJECT 8: Unmanned FAA Airway Facilities Buildings and Plant Equipment

Purpose: This program develops new standards and upgrades existing buildings and plant equipment to provide adequate plant facilities for operation and maintenance of unmanned electronic facilities. These buildings house navigation, communications, surveillance, or landing systems.

Regions typically have accomplished facility improvement work with regional personnel or by individual contracts managed by the region. The work has been accomplished on an as-needed basis dependent on manpower and funds availability.

The large number of buildings approaching the end of their normal service life (generally 20 to 30 years) has created a need for a national program. It is quite probable that it will be more economical to replace some older buildings than to modernize them.

Approach: The practice of performing modifications according to the needs of the moment and tailoring these modifications to the requirements (climate, existing equipment mixes) reduces the degree of standardization between facilities. A systems approach will provide improved standardization and decreased support costs. A comprehensive national plan will be developed to provide new standards and implement modernization and improvement projects.

Many existing unmanned Airway Facilities buildings will continue to be used for the next 20 years. Much of the original electronic equipment installed in these buildings has been or will be replaced with a newer generation of equipment with environmental, size, and maintenance requirements that are substantially reduced. Appropriate modification will be made to adapt these facilities to the new equipment requirements and, thereby, reduce operational costs.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

Modifications to repairable facilities will be made to keep the buildings in a usable condition through the year 2000. Modifications will include improvements to the buildings' weather tightness, installation of cost-beneficial insulation, and other changes for energy conservation.

Building modifications will be made to provide for co-locating navigation and communication systems at some sites. New standard designs will be developed for new facilities such as consolidated communications, ASR 9, 3D radar, etc.

Tramways will be provided for safe, dependable access to mountaintop ARSRs and will reduce the need for costly road maintenance and specialized vehicles.

This project and the Power Systems project are closely coupled. Electrical and mechanical work described therein will be completed in consonance.

Products:

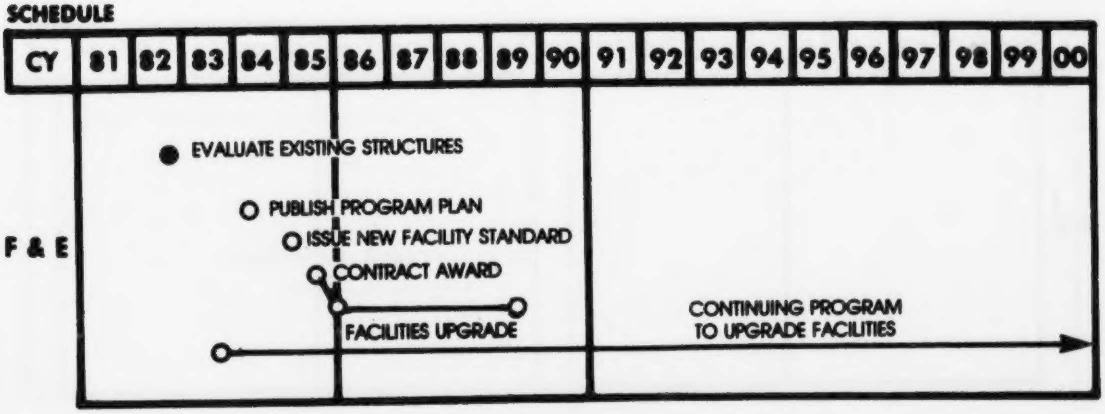
- Approximately 800 separate improvements will be made at 300 facilities during each of the first 8 years of the program.

- Approximately 150 separate improvements will be made at 60 facilities each year for the remainder of the program.

- Five tramways will be built to service mountaintop ARSR sites.

Related Projects/Activities: Communication facilities consolidation, Power Systems.

SCHEDULE



PROJECT 9: ARTCC Plant Modernization

Purpose: This project will assure that adequate facilities are provided for air route traffic control centers. Certain portions of the ARTCC buildings have been operating in their present configuration since the early 1960's. Within the next 5 years, much of the existing plant and structures will require replacement, refurbishment, or upgrading. In addition, new requirements have surfaced due to changing energy, safety, security needs, and new equipment installations.

Approach: Headquarters will provide modernization designs through an architectural/engineering contract. Construction will be by regional contracts. Construction in en route centers specifically required for the implementation of the host computer and the advanced automation system will be funded under the advanced automation program.

Building rehabilitation and modernization include:

- HVAC system replacement or upgrade and electrical system replacement or upgrade.
- Refurbishing of interiors, asbestos control, and OSHA compliance.
- Security enhancements.
- Energy conservation.
- Grounds, roads, and parking upgrade.
- Reroofing.

Products: A total of 25 en route ARTCC facilities will be involved as follows:

- The 20 existing CONUS centers may house area control facilities and will be upgraded as appropriate to provide an additional 20 to 30 years of service.
- Two offshore centers will continue in service indefinitely as ACFs and will receive appropriate upgrades and possible expansion.
- The New York TRACON will become an ACF and may recieve some similar modernization.
- The remaining offshore centers are scheduled to be phased out in the intermediate time frame and will receive only selected improvements.

Related Projects/Activities: Nearly every NAS modernization project relates directly or indirectly to the ARTCC facility; however, installation of the host computer, the advanced automation system, and the establishment of 23 area control facilities (ACF) will have the largest impact.

SCHEDULE

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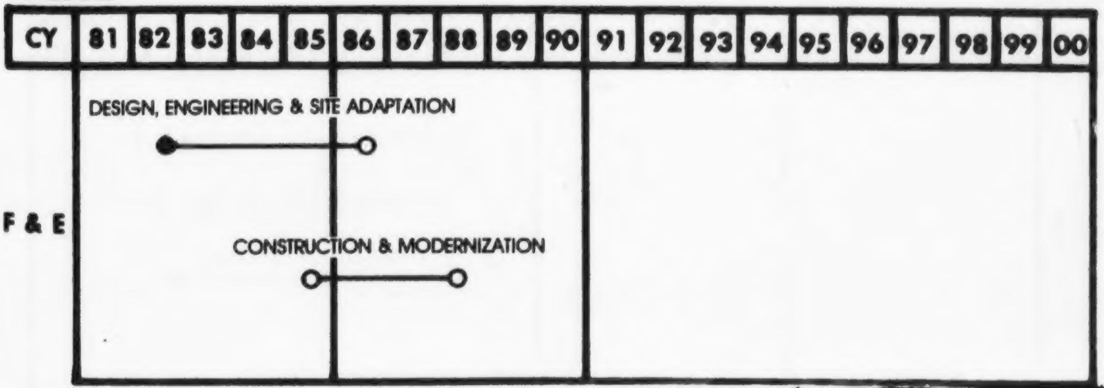
R & D																				

SCHEDULE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F & E
DESIGN, ENGINEERING & SITE ADAPTATION
CONSTRUCTION & MODERNIZATION

PROJECT 10: Acquisition of Flight Service Facilities

Purpose: The objective of this project is to acquire the space required to accommodate the modernized FSS configuration of 61 facilities.

Approach: Space for the 61 automated FSSs will be required on a sponsor-provided leased basis at selected airports throughout the United States and Puerto Rico. The 61 facilities will be designed in accordance with standard FAA operational and technical requirements. These 61 automated facilities will range from 8,000 to 12,000 square feet and be large enough to accommodate all personnel and equipment requirements.

The following factors will be considered in evaluating sponsors' proposals for building facilities:

- Life-cycle cost which includes all FAA costs associated with a particular location such as one-time costs, lease costs, maintenance, utility, and service costs.

- Building factors which include location on airport and parking provisions, suitability of technical and administrative space, and electrical distribution and telephone facilities.

- Other factors include telephone exchange capability, number of employees to be relocated, availability of quality housing, number of aircraft operations, and number of based aircraft.

Products: 61 automated flight service stations.

Related Projects/Activities: The flight service automation system (FSAS) program will provide the specialist position equipment (i.e., keyboards, displays, printers) required to support FSS specialist functions at the 61 AFSSs.

The integrated communications switching system (ICSS) shall provide the computer-based switching and control equipment required to support FSS air-ground and ground-ground voice communications.

The radio control equipment project will provide new standardized solid-state tone control equipment to accommodate the consolidation of 317 FSSs into the 61 AFSSs.

SCHEDULE

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R & D																				

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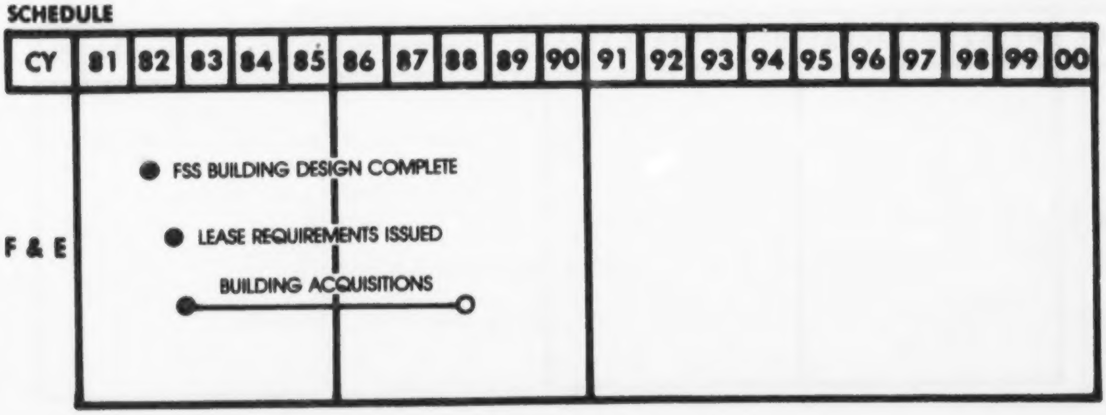
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F & E
FSS BUILDING DESIGN COMPLETE
LEASE REQUIREMENTS ISSUED
BUILDING ACQUISITIONS

PROJECT 11: Aircraft Fleet Conversion/Flight Inspection Modernization

Purpose: This project will reduce costs associated with flight programs necessary for meeting the agency's requirement to maintain a high level of safety for the flying public.

Aviation fuel costs have risen in the last several years and are expected to continue to increase. Industry forecasters are also expressing concern over the continuing availability of adequate fuel supplies. Selective replacement of agency aircraft with fuel-efficient aircraft will provide significant reductions in operational and maintenance costs and fuel consumption.

- Replacement of flight inspection aircraft will result in an annual operations savings of $9.7 million and 3.5 million gallons of fuel. Cost avoidance of $39.6 million for major modifications will be achieved through elimination of requirements to retrofit Sabreliner engines, perform wing modifications, and service life-extension modifications.

- Replacement of aircraft and related equipment will result in an annual operations savings of $6.2 million and reduce fuel consumption by 2.0 million gallons.

Approach: Replace aircraft presently used to support the agency's five flight programs with fuel-efficient aircraft, employ light-weight flight inspection systems, and upgrade automatic flight inspection systems to increase computer storage capacity and reduce processing time.

Products:

- Flight Inspection Program.

  —19 Turboprop aircraft
  — 5 Special mission turboprop aircraft
  — 1 Multipurpose flight inspection logistics aircraft (Alaska)
  — 2 Light long-range jets (Pacific)
  — 5 Portable flight inspection packages
  —42 Upgraded automatic flight inspection systems and avionics

- Flight Programs.

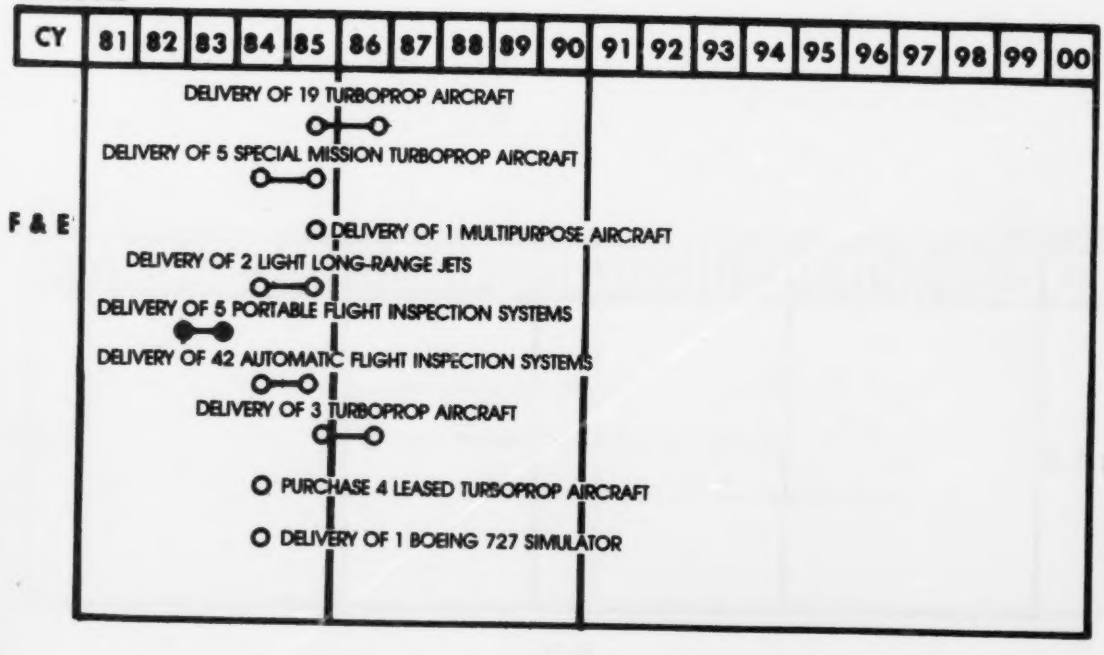
  — 7 Turboprop aircraft
  — 1 Boeing 727 simulator
  — 1 Flight inspection trainer with upgraded avionics and flight control systems

Related Projects/Activities: General Support Laboratory.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
*R & D																				

SCHEDULE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F & E
DELIVERY OF 19 TURBOPROP AIRCRAFT
DELIVERY OF 5 SPECIAL MISSION TURBOPROP AIRCRAFT
DELIVERY OF 1 MULTIPURPOSE AIRCRAFT
DELIVERY OF 2 LIGHT LONG-RANGE JETS
DELIVERY OF 5 PORTABLE FLIGHT INSPECTION SYSTEMS
DELIVERY OF 42 AUTOMATIC FLIGHT INSPECTION SYSTEMS
DELIVERY OF 3 TURBOPROP AIRCRAFT
PURCHASE 4 LEASED TURBOPROP AIRCRAFT
DELIVERY OF 1 BOEING 727 SIMULATOR

PROJECT 12: Aircraft and Related Equipment

Purpose: This project will provide direct support to the FAA aircraft fleet. It will ensure that the aircraft remain state-of-the-art, current, and safe.

Approach: The aircraft fleet conversion/flight inspection modernization program is well on the way towards implementation. Ongoing efforts will ensure that aircraft used in support of the National Airspace System provide the required capability and functions. The ongoing efforts will meet the requirements for Loran C, microwave landing system, Mode S, GPS, flight management, improved aerodynamics, and other state-of-the-art enhancements not presently identified.

Products: Mission-ready aircraft upgraded to provide required services on a global as well as domestic basis for MLS, Loran, GPS, and other systems as implemented.

Related Projects/Activities: Airborne support complex.

This project is an expansion from the 1983 edition project titled Aircraft Fleet Conversion/Flight Inspection Modernization.

SCHEDULE

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R & D																				

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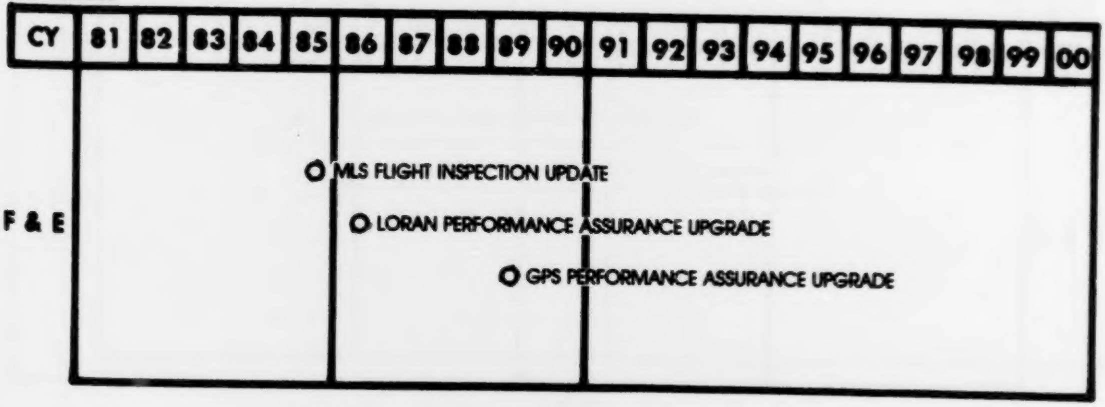
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F & E
MLS FLIGHT INSPECTION UPDATE
LORAN PERFORMANCE ASSURANCE UPGRADE
GPS PERFORMANCE ASSURANCE UPGRADE

PROJECT 13: System Engineering and Integration Contract

Purpose: This project will provide management and technical support for the implementation of the NAS Plan. The complexity and high visibility of this Plan requires that unified contractual support be provided to:

- Audit the NAS Plan and provide annual updates.
- Ensure compatibility of existing and evolving systems.
- Identify and compare alternative implementation strategies.
- Assess program impacts.
- Refine technical, cost, and schedule estimates.
- Review technical proposals.
- Evaluate alternative designs.
- Provide technical direction to subsystem contractors.
- Ensure developed items meet specified requirements.
- Integrate subsystems into the operational system.

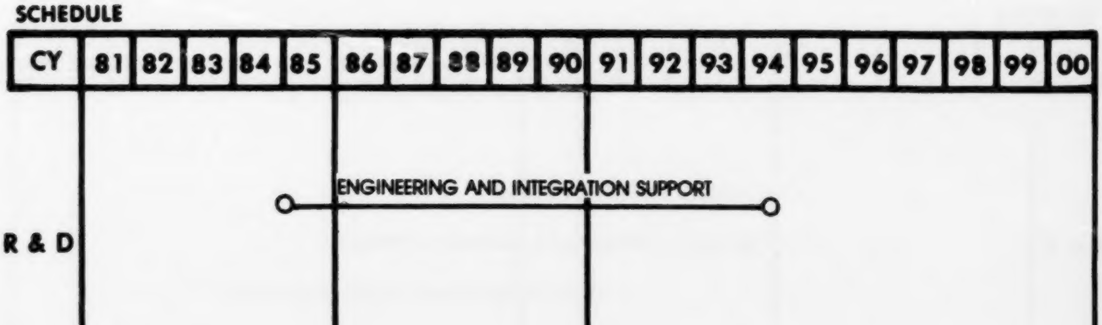
The requirement for technical expertise in the support of the large systems engineering and implementation effort cannot be met with the available FAA staff.

Approach: A multiyear contract awarded in 1984 will provide the skills and support tools necessary for implementation of the NAS Plan and integration of all acquired systems.

Products: Engineering documentation and management support for:

- Initial NAS Plan audit and annual updates.
- Program support in the development of: functional requirements statements, feasibility and trade studies, performance analysis and model, system designs, system integration plans, system implementation strategies, logistics, and training plans.
- Project management support for requirements analysis, specification development, procurement package review, proposal evaluation, contract monitoring and technical evaluation, and direction of field installation.
- Control tools and systems for benefits analysis, cost analysis, schedule analysis, risk analysis, configuration management, and program control and monitoring.

Related Projects/Activities: All NAS Plan projects.



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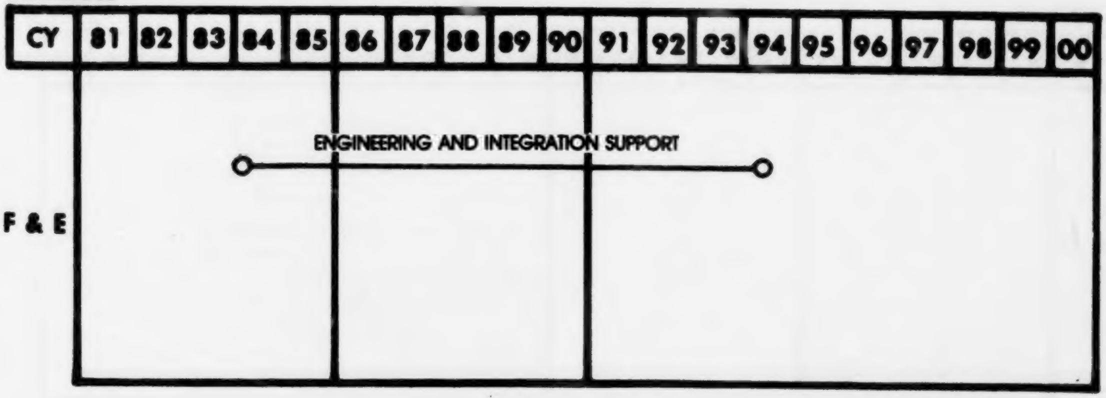
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ENGINEERING AND INTEGRATION SUPPORT
F & E

PROJECT 14: National Radio Communications System (NARACS)

Purpose: In the event of a national or local emergency which may temporarily disrupt landline communications between NAS facilities, the FAA must have the capability to reestablish normal command and control communications entirely by radio without any dependence upon landlines. The establishment of a national radio communications system (NARACS) will provide complete communications coverage with FAA headquarters, regions, the traffic management system, field facilities, aircraft accident sites, and other government agencies. In addition, the network will also be available for routine purposes on a daily basis for use in dispatching and redirecting Airway Facilities maintenance technicians, aviation security, accident investigations, and other NAS activities.

Approach: The NARACS will be based on National Security Decision Directives, NSDD-47, -95, -97 and PD-24, -58. Phase I is the establishment of a high-frequency/single sideband (HF/SSB) backbone system, or control network with nodes, at FAA headquarters, including traffic management system, and at three emergency operating facilities. Seattle and Anchorage HF/SSB radio systems will be upgraded to enable them to operate as an extension of the backbone network. The backbone network will also have voice privacy.

Phase IA will upgrade and enhance the communications security (COMSEC) program with automated digital network (AUTODIN) data network and with a secured telecommunications voice network, model II (STU II).

Phase II will establish two geographical networks with HF/SSB radio communications equipment to interface with the national command/control backbone communications network. The two networks, called Eastern and Western Nets, will provide radio communications with the regional offices, ARTCCs, major airports, FAA support aircraft, and other key facilities within each area. These networks will have the capability to transmit voice messages in the clear or voice privacy mode and to interface with the traffic management system.

Phase III will provide highly reliable two-way radio communications, which is independent of common telecommunications carrier, in any location in the region as well as in the United States with proper automatic/manual interfacing and linking with other networks of NARACS. Each regional network will become an integral part of NARACS. Network design will enhance and support the maintenance 80's concept where technicians will be dispatched to facilities from central maintenance work centers via mobile, repeaters, and fixed base radios. The networks will also be utilized for scheduling assignments, issuing reports, and for emergencies. The regional networks will be capable of transmitting messages in the unsecure voice mode or data encryption standard (DES) mode.

SCHEDULE

CY	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
R & D																				

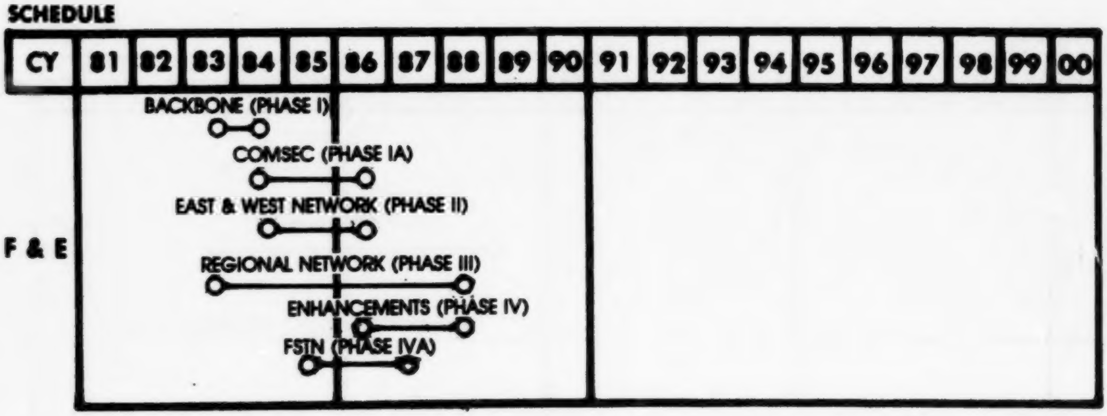
Phase IV will expand and enhance the HF/SSB backbone network for full duplex, voice, and data transmission. This effort will include the establishment of remote sites at Atlanta and Denver and provide HF radio transceivers at automated flight service stations and radio links for the remote sites including the facilities in the Washington headquarters area. The enhancement program shall also include the capability to interface with the FAA telecommunications and traffic management systems.

Phase IVA will establish the federal secure telephone network (FSTN) at Washington headquarters, regional offices, ARTCCs, and other major field offices.

Products:

- Phase I—Communications Control Center, FAA headquarters, and three engineering operations facilities.
- Phase IA—COMSEC networks.
- Phase II—eastern and western networks.
- Phase III—regional networks.
- Phase IV—duplex system for backbone network.
- Phase IVA—federal secure telephone network.

Related Projects/Activities: Usage for repeater-to-repeater connectivity, NAS spectrum engineering.



PROJECT 15: NAS Spectrum Engineering

Purpose: This project will provide spectrum utilization support necessary for the interference-free operation of the modernized NAS. The NAS is dependent upon the use of radiofrequency spectrum. Therefore, effective management of the radio spectrum including electromagnetic compatibility aspects is vital to the implementation of the NAS Plan.

Approach: Review all F&E projects to determine the scope of their frequency requirements. Develop frequency plans to ensure that adequate spectrum is available for each F&E project requiring frequencies. Obtain and protect necessary frequencies for the modernized NAS facilities using automated computer models to the extent possible. Develop, test, and evaluate electromagnetic compatibility (EMC) guidelines and frequency support capabilities necessary for the design of compatible consolidated NAS facilities. Provide facility coverage charts necessary for proper engineering of frequencies as well as for networking and facility consolidation.

Products:

- Near-term and long-term frequency plan in support of the NAS Plan (MLS frequency plan, high altitude EFAS frequency plan, 25 kHz air-ground communications frequency plan, RML frequency plan, national radio communications system plan, etc.)

- EMC guidelines and frequency support capabilities for facility consolidation.

- Frequency authorization and formal spectrum approval from the National Telecommunications Information Agency.

- Facility coverage charts.

Related Projects/Activities:

- All F&E projects requiring spectrum support (MLS, ASR 9, ASDE 3, NARACS, facility consolidation, etc.)

- System support laboratory at the Technical Center.

SCHEDULE

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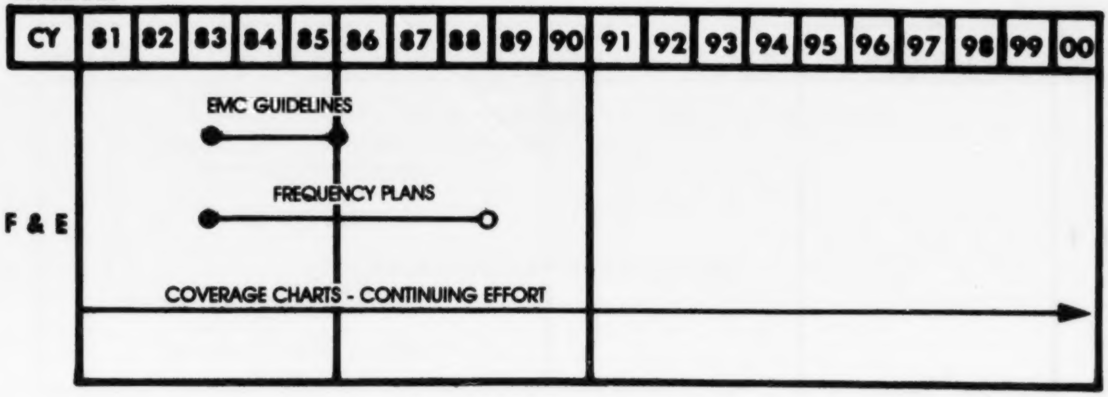
R & D																				

SCHEDULE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F & E
EMC GUIDELINES
FREQUENCY PLANS
COVERAGE CHARTS - CONTINUING EFFORT

PROJECT 16: General Support

Purpose: This project covers efforts in direct support of the overall National Airspace System and the ongoing F&E investments that are not covered elsewhere in the plan. They generally improve operations, provide added capabilities, and promote safety.

Approach: Nonrecurring low-cost F&E projects which have been included in recent budget requests are: information processors for the aviation safety analysis system; universal printed circuit board (pcb) testers for installation at planned consolidated maintenance facilities; explosive detection systems for operational evaluation; a mechanized material handling system; an automated logistics, inventory, and field requisitioning system at the Aeronautical Center Depot; and a computer-aided engineering drafting system at each regional office.

Certain ongoing efforts must continue to support the National Airspace System. These include: in-house and contractual engineering, design, and analysis for quick reaction engineering and other technical assistance; minor regional and locally identified modifications, refurbishments, and equipment relocations; improvement and leasing of plant and facilities; procurement, rehabilitation, or replacement of equipment for use in the engineering and development programs at the FAA Technical Center; where cost beneficial, purchasing land or acquiring protective easements for existing facilities rather than continuing to lease properties; and projects to meet Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) standards at FAA facilities.

Product:

- Nonrecurring projects:
  - Information processors to support the aviation safety analysis system.
  - Printed circuit board testers.
  - Four explosive detection systems for evaluation.
  - Mechanized material handling system.
  - Automated logistics, inventory, and field requisitioning system.
  - Upgrade the Technical Center plant support complex.
  - Computer aided engineering drafting systems.
- Ongoing projects:
  - Engineering, designs, and analyses.
  - Regional and local minor projects.
  - Improvements of the plant and facilities at the FAA Technical Center.
  - FAA Technical Center building lease.
  - Purchase of land and easements.
  - OSHA and EPA improvements.

Related Projects/Activities: This program supports ongoing F&E efforts and operations.

SCHEDULE

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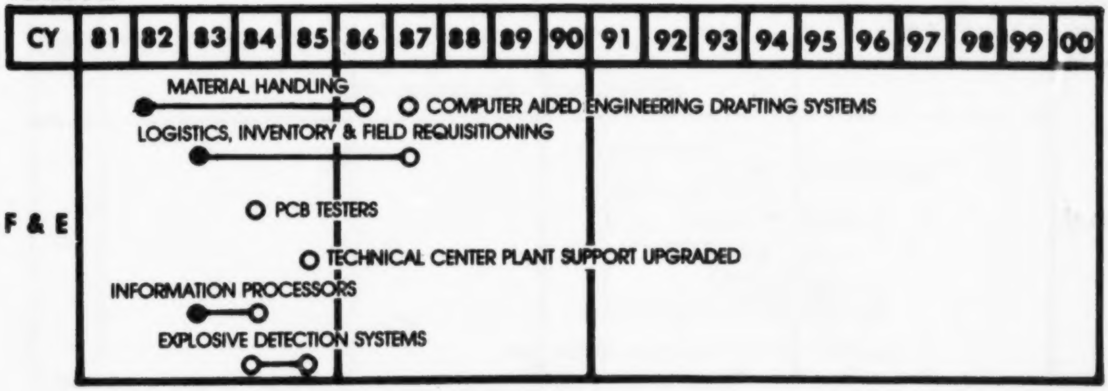
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F & E
MATERIAL HANDLING
COMPUTER AIDED ENGINEERING DRAFTING SYSTEMS
LOGISTICS, INVENTORY & FIELD REQUISITIONING
PCB TESTERS
TECHNICAL CENTER PLANT SUPPORT UPGRADED
INFORMATION PROCESSORS
EXPLOSIVE DETECTION SYSTEMS

PROJECT 17: System Support Laboratory

Purpose: This project will provide technical support for the current field systems and for test, evaluation, and integration of new systems. This laboratory at the FAA Technical Center will be used for the testing and evaluation of new systems prior to acceptance and field implementation. Upon acceptance, systems are integrated into the laboratory. They will be used for direct field assistance to technicians; development and testing of hardware, software, and firmware modifications to the system; and supporting new development.

Equipment in this laboratory establishes the configuration baseline for field operational systems. Modifications are installed, tested, and baselined on these systems prior to installation at field facilities. These systems provide for centralized maintenance and field support system configurations, and interfaces are determined by the fielded systems. System-to-system interfaces are also baselined and configuration controlled.

Approach: The system support laboratory will be partitioned into six support complexes:

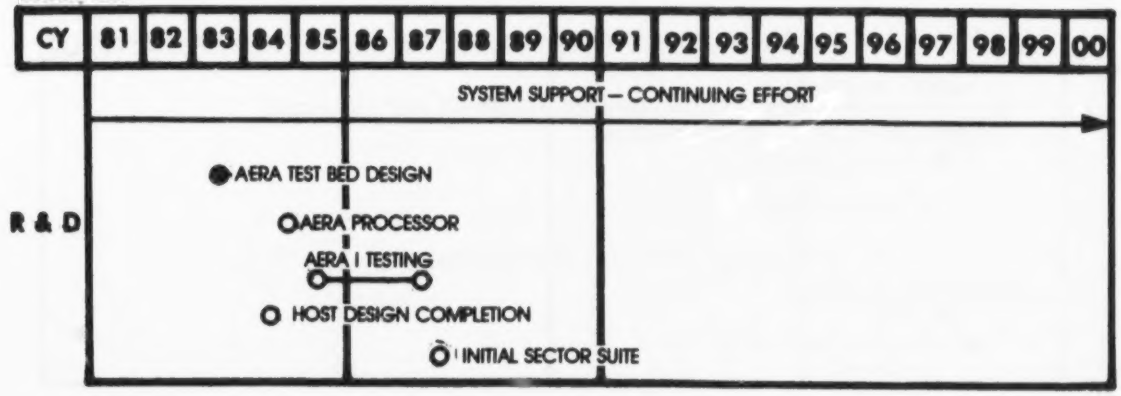
- En route systems.
- Terminal systems.
- Flight service systems.
- Ground-to-air systems.
- Interfacility communications systems.
- Auxiliary systems.

Front-end planning in consonance with the F&E projects and schedules will eliminate proliferation of laboratory facilities and equipment. Equipment maintained in the laboratory will be the minimum required to meet support needs. Equipment resources will be shared between support complexes to the extent that the prime field support mission is not degraded.

Product: System support laboratory.

Related Projects/Activities: A majority of major F&E programs.

SCHEDULE



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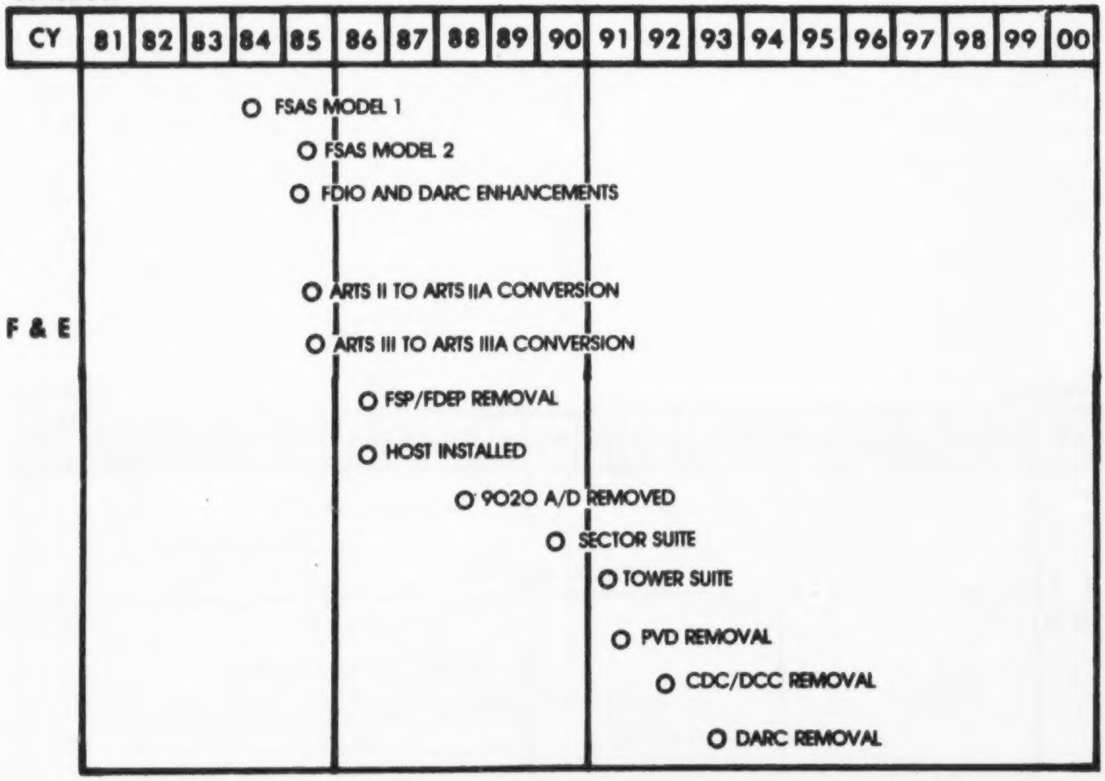
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F & E
FSAS MODEL 1
FSAS MODEL 2
FDIO AND DARC ENHANCEMENTS
ARTS II TO ARTS IIA CONVERSION
ARTS III TO ARTS IIIA CONVERSION
FSP/FDEP REMOVAL
HOST INSTALLED
9020 A/D REMOVED
SECTOR SUITE
TOWER SUITE
PVD REMOVAL
CDC/DCC REMOVAL
DARC REMOVAL

PROJECT 18: General Support Laboratory

Purpose: This project will provide general systems, equipment, and aircraft for support of the system support laboratory, other laboratories supporting R&D projects, and operational requirements.

Approach: The general support laboratory is partitioned into six distinctive complexes:

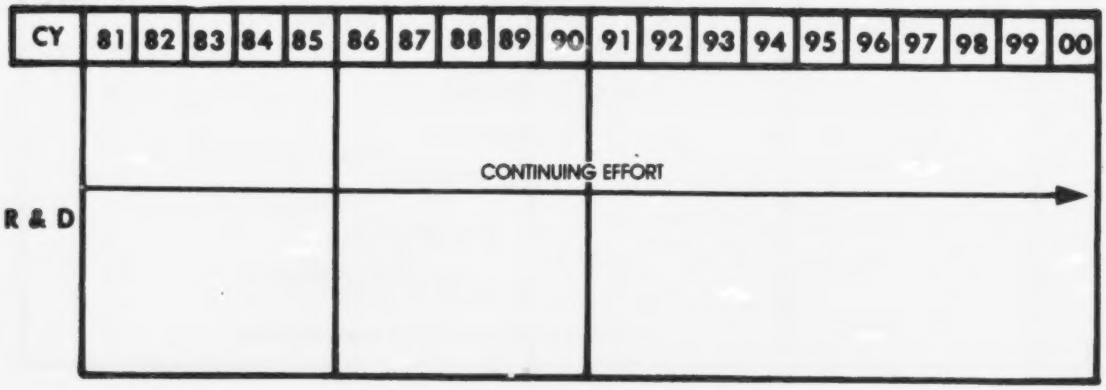
- Airborne support.
- Electromagnetic support.
- Simulation support.
- Test integration command and control.
- General purpose processing support.
- Plant support.

A plan has been developed to systematically upgrade these laboratory facilities and systems, as required, to meet the future requirements. The plan identifies criteria for the inclusion of elements within this laboratory based upon their capability to provide support to more than one of the other laboratories. For example, the general purpose data center provides computer plotting and data reduction support to the system support, research and development, and regulatory support laboratories. The aircraft fleet also supports these laboratories.

Products: An upgraded general support laboratory.

Related Projects/Activities: Many of the major F&E programs.

SCHEDULE



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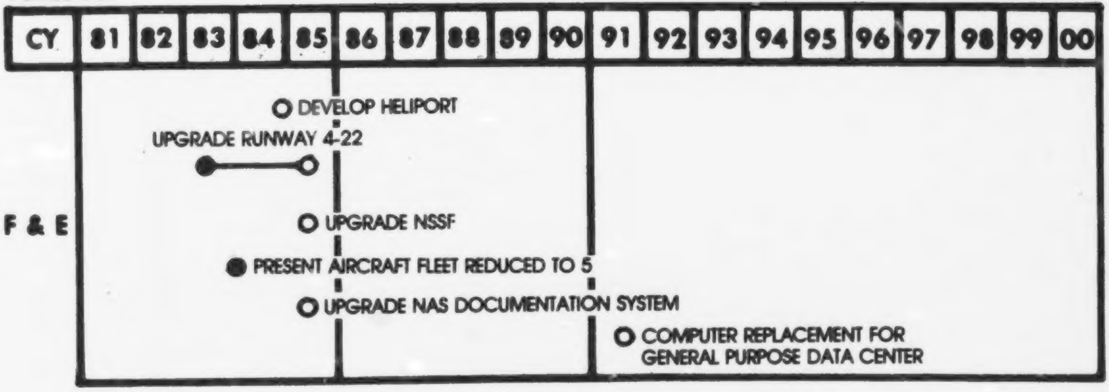
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F & E
DEVELOP HELIPORT
UPGRADE RUNWAY 4-22
UPGRADE NSSF
PRESENT AIRCRAFT FLEET REDUCED TO 5
UPGRADE NAS DOCUMENTATION SYSTEM
COMPUTER REPLACEMENT FOR GENERAL PURPOSE DATA CENTER

GLOSSARY OF ACRONYMS

GLOSSARY OF ACRONYMS

AAP	advanced automation program
AAS	advanced automation system
ABDIS	class A interim NADIN computerized BDIS terminal at Kansas City ARTCC and NATCOM
ACF	area control facility
AERA	automated en route air traffic control
AF	Airway Facilities
AFSS	automated flight service station
AFTN	aeronautical fixed telecommunications network
A/G	air-to-ground
agl	above ground level
AIP	Airport Improvement Program
AIRMET	airmen's meteorological information
AIS	aeronautical information system
ALS	approach light system
ALSF	approach light system with sequence flasher
ALSIP	approach lighting system improvement program
APS	Airway Planning Standard
ARF	Airport Reservation Function
ARINC	Aeronautical Radio, Incorporated
ARSR	air route surveillance radar
ARTCC	air route traffic control center
ARTS	automated radar terminal system
ASDE	airport surface detection equipment
ASR	airport surveillance radar
AT	Air Traffic
ATARS	automatic traffic advisory and resolution service
ATC	air traffic control
ATCBI	air traffic control beacon interrogator
ATCCC	Air Traffic Control Command Center
ATCRBS	air traffic control radar beacon system
ATCT	airport traffic control tower
ATIS	automatic terminal information service
AUTODIN	automated digital network
AWANS	aviation weather and NOTAM system
AWOS	automated weather observation system
AWP	aviation weather processor
BDIS	automatic data interchange system, service B
bps	bits per second
BRITE	bright radar indicator terminal equipment
BUEC	backup emergency communications
CA	conflict alert
CARF	Central Altitude Reservation Function
CBI	computer based instruction
CCD	consolidated cab display
CCP	contingency command post
CD	common digitizer
CERAP	combined center radar approach control
CFCF	Central Flow Control Function
CFWP	central flow weather processor
CFWSU	central flow weather service unit
CNS	consolidated NOTAM system

COMLO	compass locator
COMSEC	communications security
CONUS	continental, contiguous, or conterminous United States
CRF	central repair facility
crt	cathode-ray tube
CWP	central weather processor
CWSU	center weather service unit
DABS	discrete address beacon system
DARC	direct access radar channel
dc	direct current
DES	data encryption standard
DF	direction finder
DME	distance measuring equipment
DME/P	precision distance measuring equipment
DOD	Department of Defense
DOT	Department of Transportation
DSB	double sideband
DUAT	direct user access terminal
DVOR	Doppler very high frequency omnidirectional range
EARTS	en route automated radar tracking system
E-DARC	enhanced direct access radar channel
EFAS	en route flight advisory service
EMC	electromagnetic compatibility
EPA	Environmental Protection Agency
ERL	Environmental Research Laboratories
ERM	en route metering
ETABS	electronic tabular display system
ETG	enhanced target generator
FAA	Federal Aviation Administration
FDEP	flight data entry and printout
FDIO	flight data input/output
F&E	facilities and equipment
F,E&D	facilities, engineering, and development
FIR	flight information region
FM	frequency modulation
FPS	military primary radar
FSAS	flight service automation system
FSDPS	flight service data processing system
FSP	flight strip printer
FSS	flight service station
FSTN	federal secure telephone network
FWCS	flight watch control station
GFE	government furnished equipment
GOES	geostationary operational environmental satellite
GPO/GPI	general purpose output/general purpose input
GPS	global positioning system
GSA	General Services Administration
GSL	general support laboratory
H	homing radio beacon
HH	homing radio beacon high power
HF	high frequency
HIWAS	hazardous in-flight weather advisory service
HUD	head-up display
HVAC	heating, ventilating, and air conditioning
IBM	International Business Machines
ICAO	International Civil Aviation Organization

ICSS	integrated communications switching system
IFM	integrated flow management
IFR	instrument flight rules
ILS	instrument landing system
IVRS	interim voice response system
JAWS	joint airport weather studies
JSS	joint surveillance system
kHz	kilohertz
kW	kilowatt
kWh	kilowatthour
LLWAS	low level wind shear alert system
LRU	lowest replaceable unit
MALSR	medium-intensity approach lighting system with runway alignment indicator lights
MAR	minimally attended radar
MCC	maintenance control center
MED	manual entry device
MHz	megahertz
MLS	microwave landing system
MMS	maintenance management system
Mode C	altitude reporting mode of secondary radar
Mode S	discrete addressable secondary radar system with data link
modem	modulator-demodulator
MOS	metal-oxide semiconductor
MPS	maintenance processor subsystem
MSAW	minimum safe altitude warning
msl	mean sea level
NADIN	National Data Interchange Network
NAR	National Airspace Review
NARACS	national radio communications system
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NASNET	national airspace system network
NASP	National Airport System Plan
NATCOM	National Communications Center, Kansas City, MO
navaid	navigational aid
NDB	nondirectional beacon
NEXRAD	next generation weather radar
NICS	NAS interfacility communications system
NMC	National Meteorological Center
NOAA	National Oceanic and Atmospheric Administration
NOTAM	notice to airmen
NPIAS	National Plan of Integrated Airport Systems
NSSF	NAS Simulation Support Facility
NTIA	National Telecommunications Information Agency
NTSB	National Transportation Safety Board
NWS	National Weather Service
ODALS	omnidirectional airport lighting system
ODAPS	oceanic display and planning system
OMB	Office of Management and Budget
ORD	operational readiness demonstration
OSHA	Occupational Safety and Health Administration
PAPI	precision approach path indicator

PATWAS	pilots automatic telephone weather answering service
pcb	printed circuit board
PCS	power conditioning system
PIREP	pilot report
ppi	plan position indicator
prf	pulse repetition frequency
PROFS	program for regional observing and forecasting services
PVD	plan view display
RADS	radar alphanumeric display system
RAIL	runway alignment indicator lights
RCAG	remote center air/ground communications facility
RCCC	regional communications control center
RCE	remote control equipment
RCF	remote communications facility
RCO	remote communications outlet
R&D	research and development
REIL	runway-end identification lights
RFP	request for proposal
RML	radar microwave link
RMM	remote maintenance monitoring
RMMS	remote maintenance monitoring system
RMS	remote maintenance subsystem
RRWDS	radar remote weather display system
RTR	remote transmitter/receiver
RVR	runway visual range
RVV	runway visibility value
SAR	system analysis recorder
SET	system embedded training
SIAP	standard instrument approach procedure
SIGMET	significant meteorological information
SSALF	simplified short approach light facility
SSALR	simplified short approach lighting system with runway alignment indicator lights
SSALS	simplified short approach light system
SSB	single sideband
SSF	system support facility
SSL	system support laboratory
SSR	secondary surveillance radar
STEP	service test and evaluation program
STU II	secured telecommunications voice network, model II
TACAN	tactical air navigation
TCAS	traffic alert and collision avoidance system
TCS	tower communications system
T&E	test and evaluation
TELCO	telephone company
TIDS	terminal information display system
TML	television microwave link
TPX	military beacon decoder
TRACAB	terminal radar approach control in the tower cab
TRACON	terminal radar approach control
TSC	DOT Transportation System Center
TSSF	terminal system support facility
TV	television
TWEB	transcribed weather broadcast
UHF	ultra high frequency

UPS	uninterrupted power source
USAF	United States Air Force
VASI	visual approach slope indicator
VAX	virtual address extension — series of 32-bit equipment manufactured by Digital Equipment Corporation
VFR	visual flight rules
VHF	very high frequency
VLF	very low frequency
VOR	VHF omnidirectional range
VORTAC	VOR collocated with TACAN
VOT	VHF omnidirectional range test
VRS	voice response system
VSCS	voice switching and control system
WCP	weather communications processor
WMSC	weather message switching center
WSR	weather service radar
Wx	weather

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☆ U.S. GOVERNMENT PRINTING OFFICE: 1984-440-534